CARL CHUN

THE CEPHALOPODA

PART I: OEGOPSIDA
PART II: MYOPSIDA, OCTOPODA

ATLAS

Carl Chun

THE CEPHALOPODA

NOTE TO PLATE LXVIII

Figure 7 should read Figure 8
Figure 9 should read Figure 7

GERMAN DEEPSEA EXPEDITION 1898–1899. VOL. XVIII

SCIENTIFIC RESULTS OF THE GERMAN DEEPSEA EXPEDITION
ON BOARD THE STEAMSHIP "VALDIVIA" 1898–1899

Volume Eighteen

UNDER THE AUSPICES OF THE GERMAN MINISTRY OF THE INTERIOR

Supervised by CARL CHUN, Director of the Expedition
Professor of Zoology, Leipzig.
After 1914 continued by
AUGUST BRAUER
Professor of Zoology, Berlin

CARL CHUN

THE CEPHALOPODA

PART I: OEGOPSIDA
PART II: MYOPSIDA, OCTOPODA
ATLAS

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Since the study of the Cephalopoda is a very specialized field with a unique and specific terminology and phraseology, it was necessary to edit the translation in a technical sense to insure that as accurate and meaningful a representation of Chun's original work as possible would be achieved. We hope to have accomplished this responsibility.

Clyde F. E. Roper and Ingrid H. Roper
Technical Editors

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Carl Chun

THE CEPHALOPODA

PART I: OEGOPSIDA

ATLAS

GERMAN DEEPSEA EXPEDITION 1898–1899. VOL. XVIII, PART I

WISSENSCHAFTLICHE ERGEBNISSE

DER

DEUTSCHEN TIEFSEE-EXPEDITION

AUF DEM DAMPFER „VALDIVIA“ 1898-1899

IM AUFTRAGE DES REICHSAMTES DES INNERN

HERAUSGEGEBEN VON

CARL CHUN

PROFESSOR DER ZOOLOGIE IN LEIPZIG

LEITER DER EXPEDITION

ACHTZEHNTER BAND

CARL CHUN

DIE CEPHALOPODEN

I. TEIL: OEGOPSIDA

ATLAS

JENA

VERLAG VON GUSTAV FISCHER

1910

Eingegangen den 15. November 1909, C. Chun

PLATES

Plate I

Thaumatolampas diadema n.gen.n.sp.

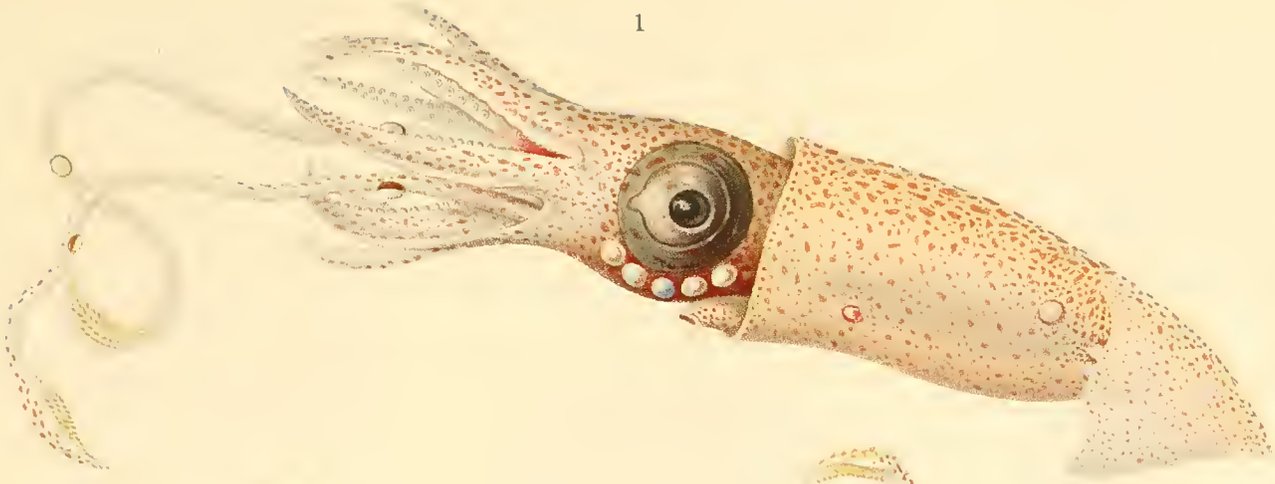
Figure 1. Specimen from Station 89, southern part of the Benguela Current. Left side. × 2.5

Figure 2. Same, ventral side. The ventral luminous organs are visible through the mantle ×

Figure 3. Specimen from Station 118; West Wind Drift, south of Cape Province. Chromatophores on mantle were abraded; the light-colored gills and branchial hearts and the brown-red stomach are visible through the mantle. × 2.5

Figures are based on color sketches of the live animal.

1



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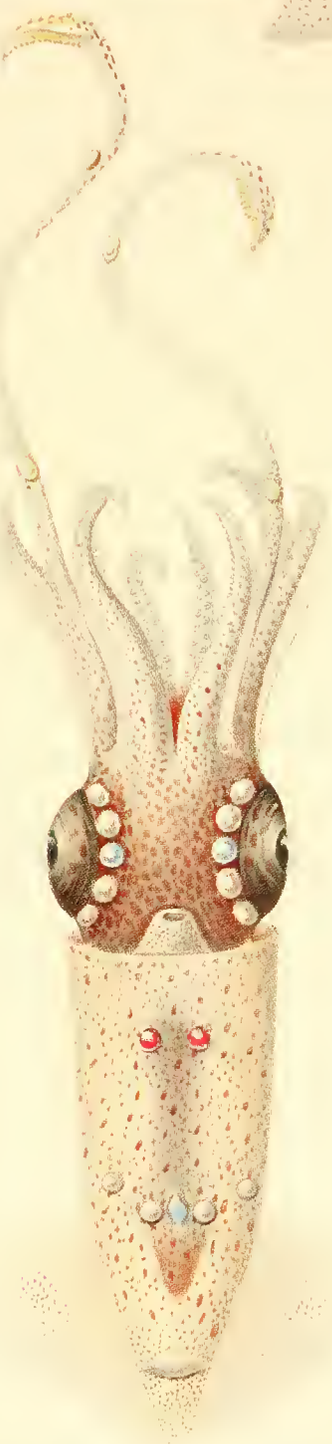


Plate II

Thaumatolampas diadema CH.

Figure 1. Luminous organs of specimen from Station 118
Drawing based on a photograph of the live animal

Figure 2. Head and funnel of specimen from Station 89, diagonally from the right. × 5.

Figure 3. Specimen from Station 118, with opened mantle cavity. × 2.5

Figure 4. Specimen from Station 89. Funnel opened to show the funnel organ, the middle part of which is situated before the anus with the two and appendages. Anal organs red

Figure 5. Mantle complex of specimen from Station 89. Richt anal organ (red) covered by vena cava

Figure 6. Buccal funnel of specimen from Station 89, ventral Attachment to ventral arms has been cut, and ventral arms and tentacles bent down.
1, *2*, *3*, *4*—points of buccal funnel

Figure 7. Deep attachment of 3rd and 4th arms.

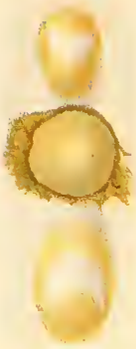
Figure 8. Central and two adjacent eye organs.
Drawn after the preserved specimen.

ABBREVIATIONS

a. post. — posterior artery
br. 3—3rd arm
br. 4 — 4th arm
c. br. — branchial heart
col. bucc. 3—3rd buccal pillar
fun. br. 4 — attachment of 4th arm
funic. t. — muscular attachment of tentacle
lam. tect. — protective membrane
luc. an — anal luminous organ
luc. br. — branchial organ
luc. tent. — organ of tentacle
luc. v. — median ventral organ
luc. v. a. — median ventral organ
luc. v. lat. — lateral ventral organ
luc. v. p. — posterior ventral organ
mu. depr. inf. — funnel depressor
mu. obl. 3—deep attachment from 3rd to 4th arm
mu. obl. 4—deep attachment from 4th to 3rd arm
mu. r. abd.—musculus rectus abdominis
nid. — nidamental gland
s. — knob on 3rd buccal pillar
tent. — tentacle
tub. olf. — olfactory tubercle
ur. — papilla of renal sac
v. abd. — abdominal vein
v. branch.—branchial vein
v. c.—vena cava
valv. — funnel valve

2

8



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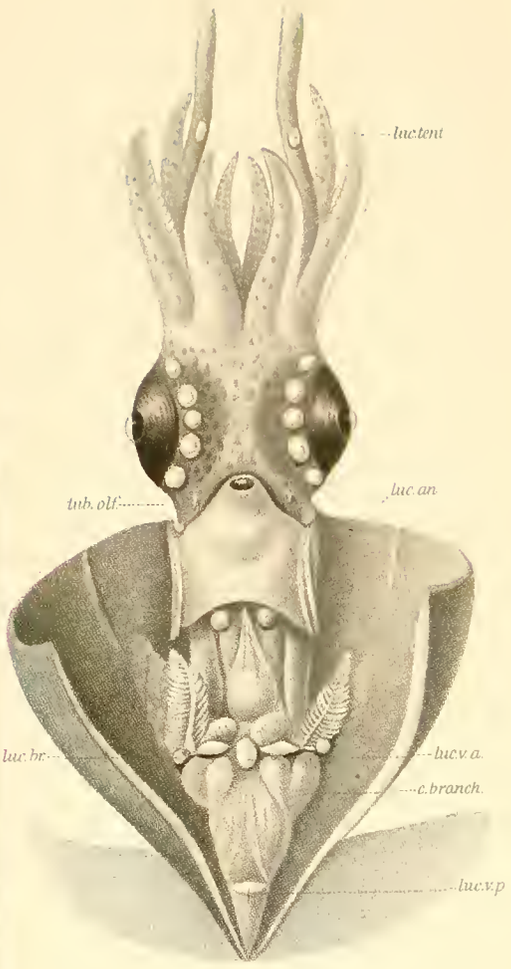
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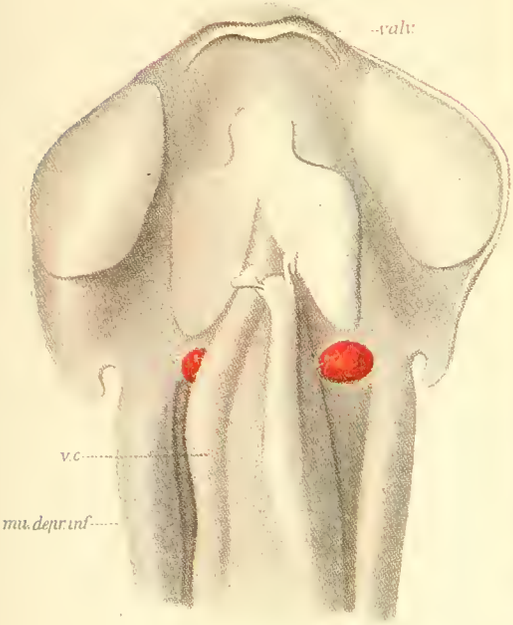
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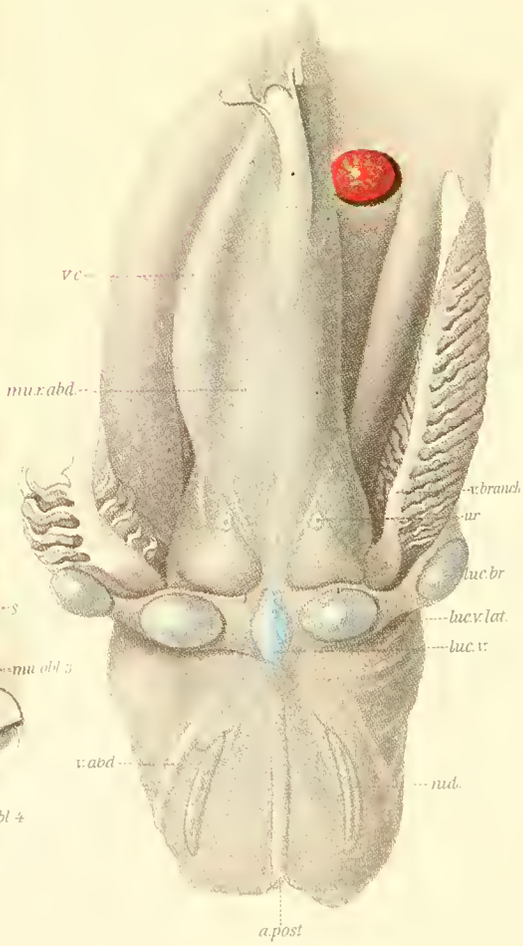
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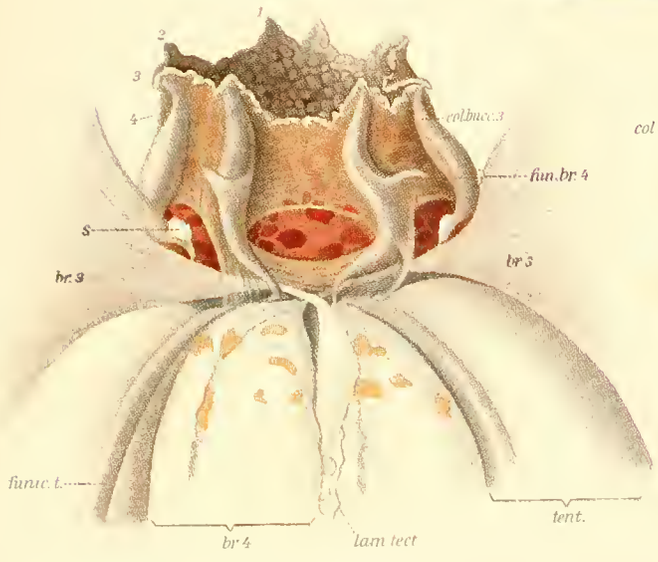
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Plate III

Thaumatolampas diadema CH.

Figure 1. Specimen from Station 89. Arm apparatus and buccal funnel. Appr. × 4
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Figure 19. Right oviduct of specimen from Station 89. × 30

ABBREVIATIONS

a. gul.—gular lamella of lower jaw
a. pal.—palatine lamella of upper jaw
a. r.—rostral wings
ann.—ring of suckers
app. c.—appendages of branchial heart
app. ren.—venous appendage of renal sac
c. br.—branchial heart
ch.—chitinous ring of sucker
chr.—chromatophores
d.—inner teeth of suckers
d'.—outer teeth of suckers
ga.—ganglionic layer in sensory knob
gl. nid.—nidamental gland
gl. ovd.—oviduct gland
lb. ext.—outer buccal lip
lb. i.—inner buccal lip
lig. br.—branchial ligament
m. depr. inf.—funnel depressor
ma.—matrix of chitinous ring
n. nerve
ovd.—oviduct
p.—muscular pad of sucker
ped.—stalk of sucker
pil.—buccal pillar
r.—rostrum
v.—vein
v. abd. d.—right abdominal vein
v. br.—branchial vein
v. p. d.—right pallial vein
vill.—buccal villi

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Plate IV

Luminous organs of *Thaumatolampas diadema* after preservation in formol-alcohol

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Cleared in oil of cloves.
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Cleared in oil of cloves.
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Figure 21. Epithelial cells of renal sac, bordering on ventral organ. Hemalum. Zeiss F. 2
Figure 22. Silken-sheeny fiber in upper distal organ of tentacle. Hemalum. Zeiss F. 2

ABBREVIATIONS

a.—pad of fibrous cells
art.—artery
c.sq.—squamous cells
c.sq.ext.—outer squamous cells
c.sq.int.—inner squamous cells
cap.—capillaries
ep.nephr.—epithelium of renal sac
fibr.—fibrous connective tissue
lam.—fine lamellae (anal organ)
luc.centr.—central luminous body (of tentacle organ)
luc.ext.—peripheral luminous body
luc.int.—inner organ of eye
luc.oc.3—3rd eye organ
luc.oc.4—4th eye organ
luc.oc.5—5th eye organ
m.—envelope (ventral organ)
mu.—muscle fibers
mu.long.—longitudinal muscles
mu.rect.abd.—musculus rectus abdominis
n.—nerves
n.tent.—nerve of tentacle
nephr.—renal sac
nu.—nuclei
nu.cap.—nuclei of capillaries
pall.—mantle
pg.—pigment
phot.—luminous body
phot.ext.—luminous body of outer organ
phot.int.—luminous body of inner organ
str.—silken-sheeny fibers
str.ext.—outer fibers
str.int.—inner fibers
tap.—tapetum
tap.ext.—outer tapetum
tap.int.—inner tapetum
v.—vein or vessel, resp.
v.c.—branches of vena cava
ven.—vein

Plate V

Abraliopsis morisii VÉR.

Mature female from Station 256 in Indian North Equatorial Current. × 2.
After color sketches of the live animal
Figure 1. Left side.
Figure 2. Ventral
Figure 3. Dorsal.

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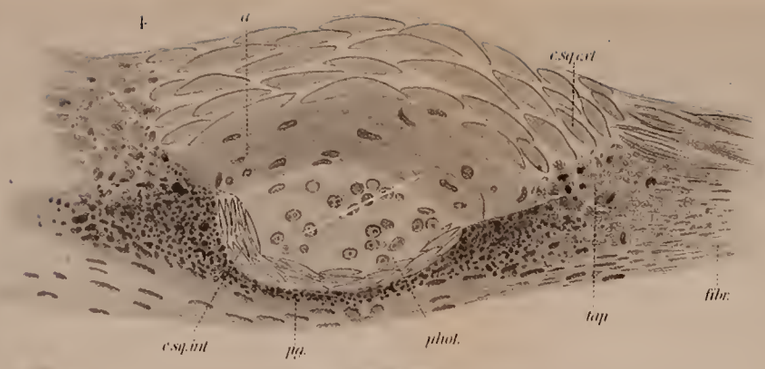
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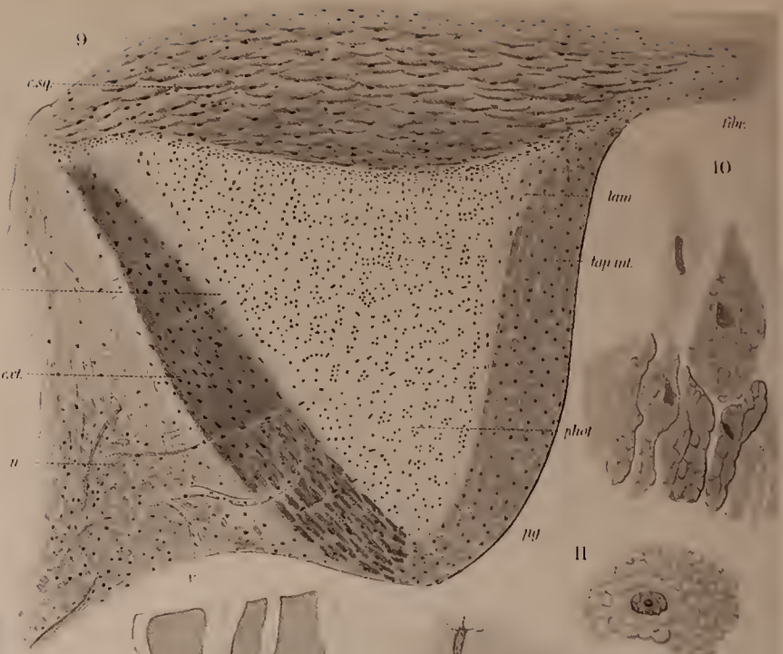
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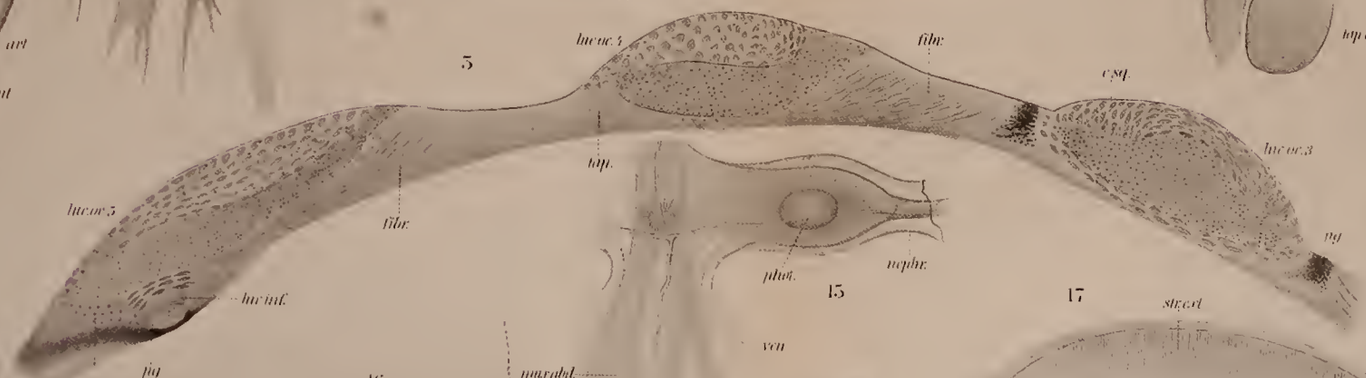
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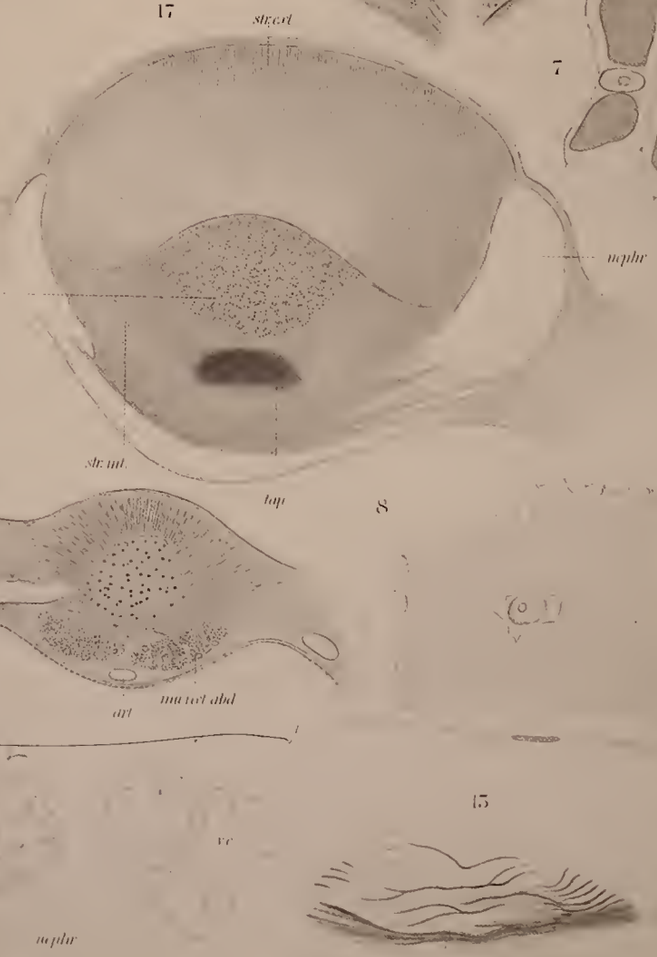
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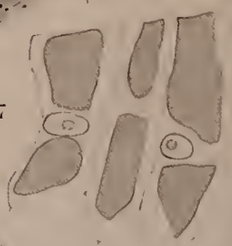
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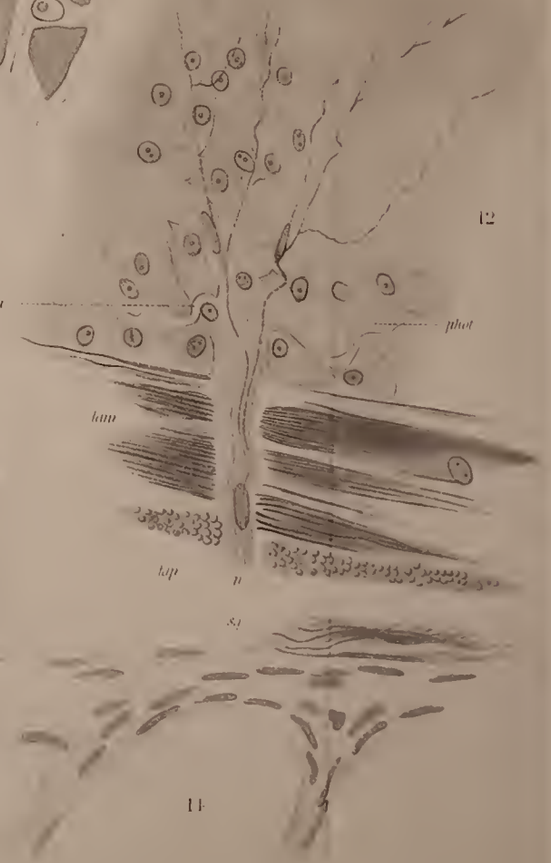
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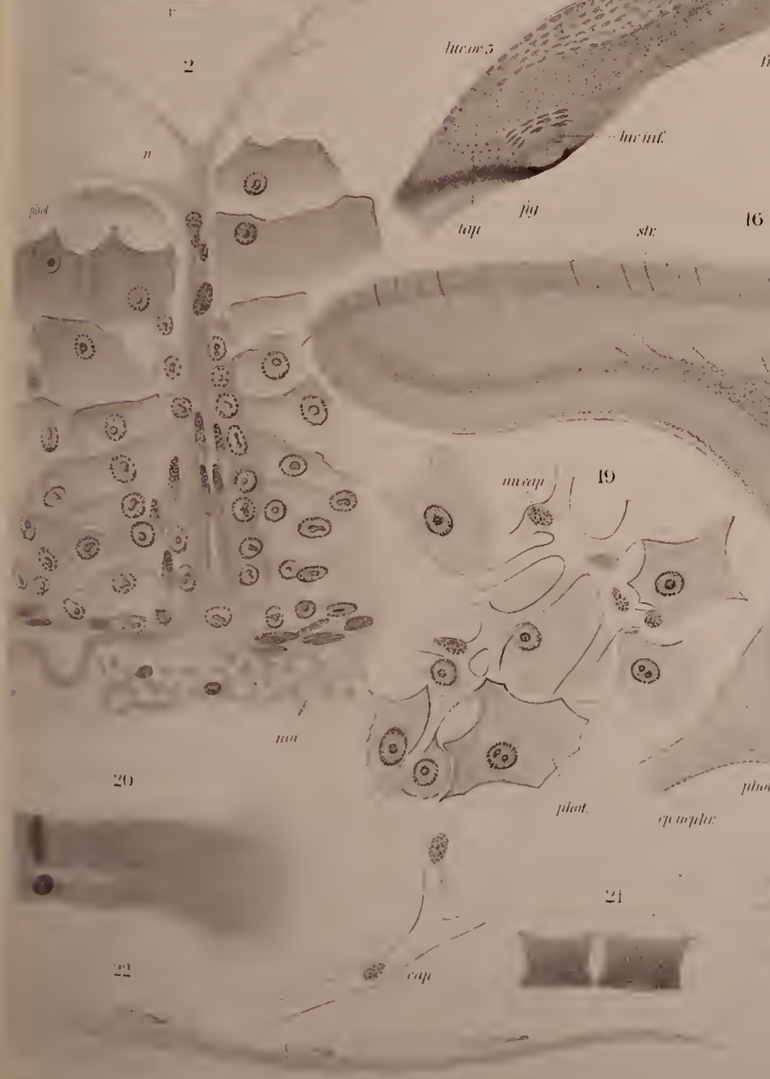
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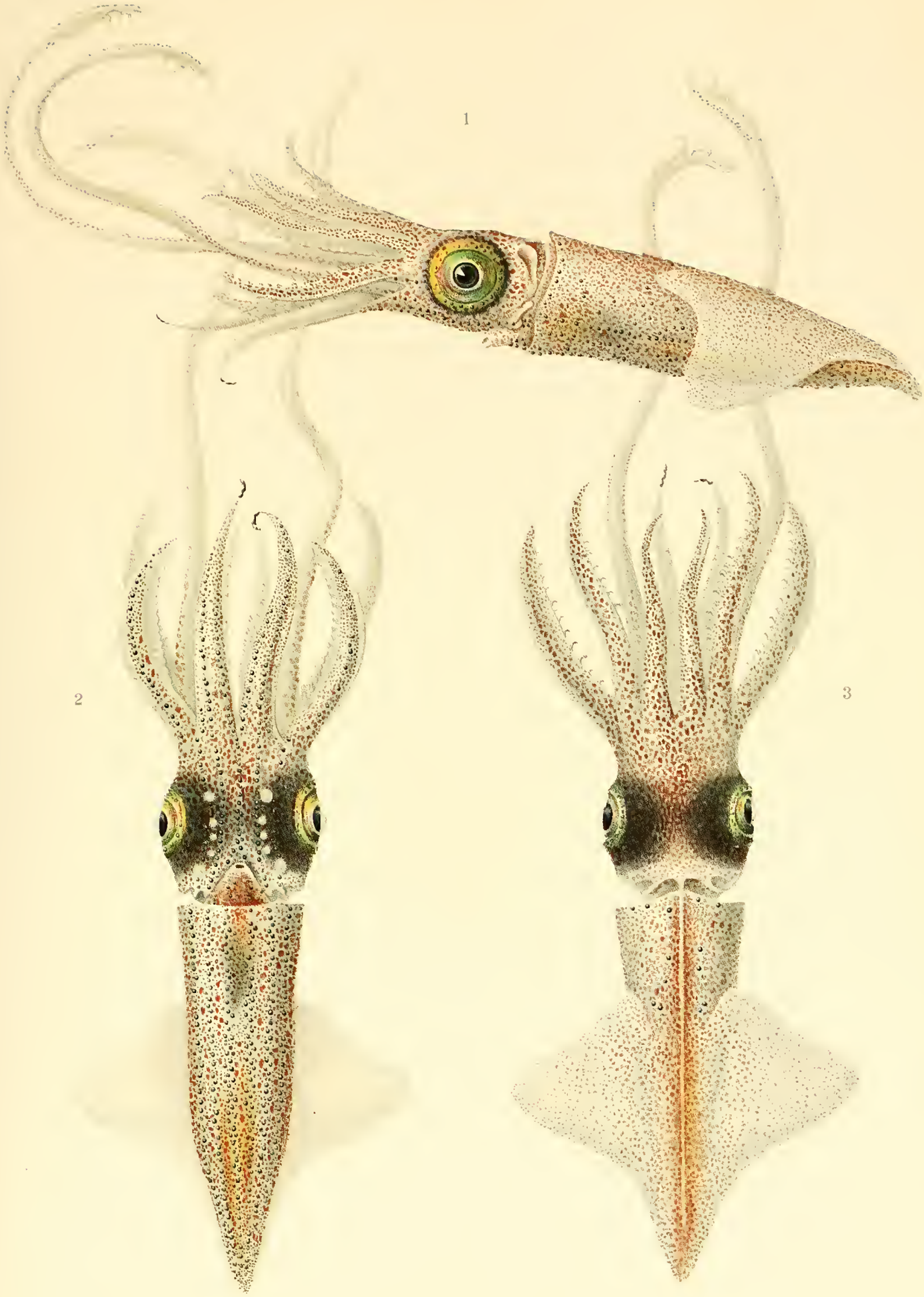
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Plate VI

Abraliopsis morisii VÉR. Male and juvenile stages

Figure 1. Male with hectocotylized left ventral arm. Station 54, Guinea Current. × 3. After color sketch of the live animal

Figure 2. Older juvenile stage from Station 54, Guinea Current. Ventral view (*Micrabralia* PFEFFER). × 6

Figure 3. Juvenile stage from Station 323, Indian Countercurrent. Ventral (*Compsoteuthis* PFEFFER)

Figure 4. Same, left side.

Figure 5. Juvenile stage from Atlantic South Equatorial Current. Right side (*Compsoteuthis* PFEFFER)

Figure 6. Same, ventral.

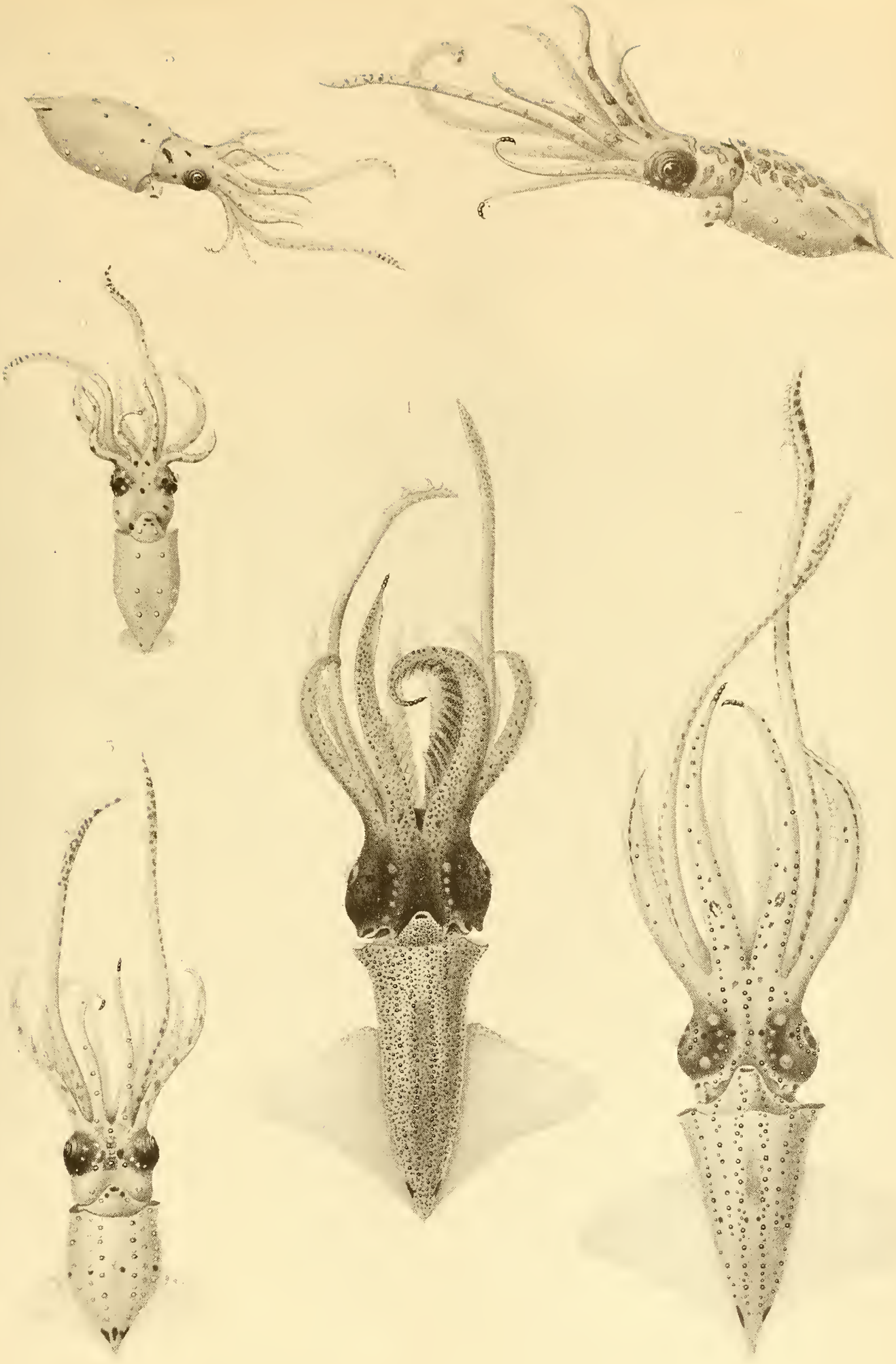

Plate VII

Young larvae of *Abraliopsis*, *Thelidioteuthis*, and of Enoploteuthidae

Figures 1–8. Larvae of *Abraliopsis*

Figure 1. Larva of *Abraliopsis*, Indian Countercurrent, Station 228. ×6. (*Compsoteuthis* Pfeffer)
Figure 2. Left tentacle club of same larva.
Figure 3. Larva from Indian Countercurrent, Station 231. Dorsal. × 6
Figure 4. Same larva. Ventral. × 6
Figure 5. Tentacle club of same larva.
Figure 6. Younger larva from Indian Countercurrent. Ventral. × 6
Figure 7. Youngest larva, ventral. Indian Countercurrent. Station 228. × 6
Figure 8. Left tentacle club of same larva.

Figures 9–13. Youngest larvae, probably belonging to the development cycle of *Abraliopsis*

Figure 9. Larva from Indian North Equatorial Current, Station 217. × 6
Figure 10. Tentacle club of larva of Figure 11.
Figure 11. Youngest larva from Station 217, lateral. × 7.3
Figure 12. Youngest larva. Guinea Current, Station 43. × 22
Figure 13. Tentacle of same larva.

Figures 14–19. Larvae of *Thelidioteuthis alessandrinii* Vér. and similar younger larvae

Figure 14. Larva from Indian North Equatorial Current, Station 218. × 10
Figure 15. Tentacle club of same larva. Appr. × 40
Figure 16. Older larva of *Thelidioteuthis* from Indian South Equatorial Current, Station 235. Ventral. × 6
Figure 17. Tentacle club of same larva. Appr. × 24
Figure 18. Larva from Indian Countercurrent, Station 223. Ventral
Figure 19. Tentacle club of same larva. Appr. × 50

Figures 20–23. Larvae that perhaps belong to *Enoploteuthis*

Figure 20. Larva from Indian North Equatorial Current, Station 218. Ventral. × 7
Figure 21. Dorsal view of same larva. × 7
Figure 22. Tentacle club of same larva.
Figure 23. Smaller larva of same species from Indian North Equatorial Current, Station 218. × 6
Figure 24. Larva from Guinea Current. Station 54. × 10
Figure 25. Tentacle club of same larva. × 50

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Plate VIII

Abraliopsis morisii VÉR. Arm apparatus and buccal funnel

Figure 1. *Abraliopsis morisii*, male. Buccal funnel viewed diagonally from the side. The 2nd and 3rd left arms are spread to show the deeper attachments; *1*—dorsal, *2*—dorsolateral, *3*—ventrolateral, *4*—ventral buccal peak

Figure 2. Arm apparatus and buccal funnel (Station 254), seen from above. × 4

Figure 3. Left tentacle club of a male. Station 256. × 15

Figure 4. Right tentacle club of a male. Station 254. × 20

Figure 5. Left tentacle club of adult male. Station 54. × 20

Figure 6. Neck cartilage. Station 254. × 9

Figure 7. Knob of ventral arm, longitudinal section of the arm.

Figure 8. Granulate cells of knob tissue. Zeiss F. 2 Pr

Figure 9. Granulate cells of knob, with capillaries (*cap.*). Zeiss F. 2 Pr

ABBREVIATIONS

cap.—capillaries
fun. br. 2—deep attachment from 2nd to 3rd arm
fun. br. 3—deep attachment from 3rd to 2nd arm
fun. tent.—muscle of attachment of tentacle

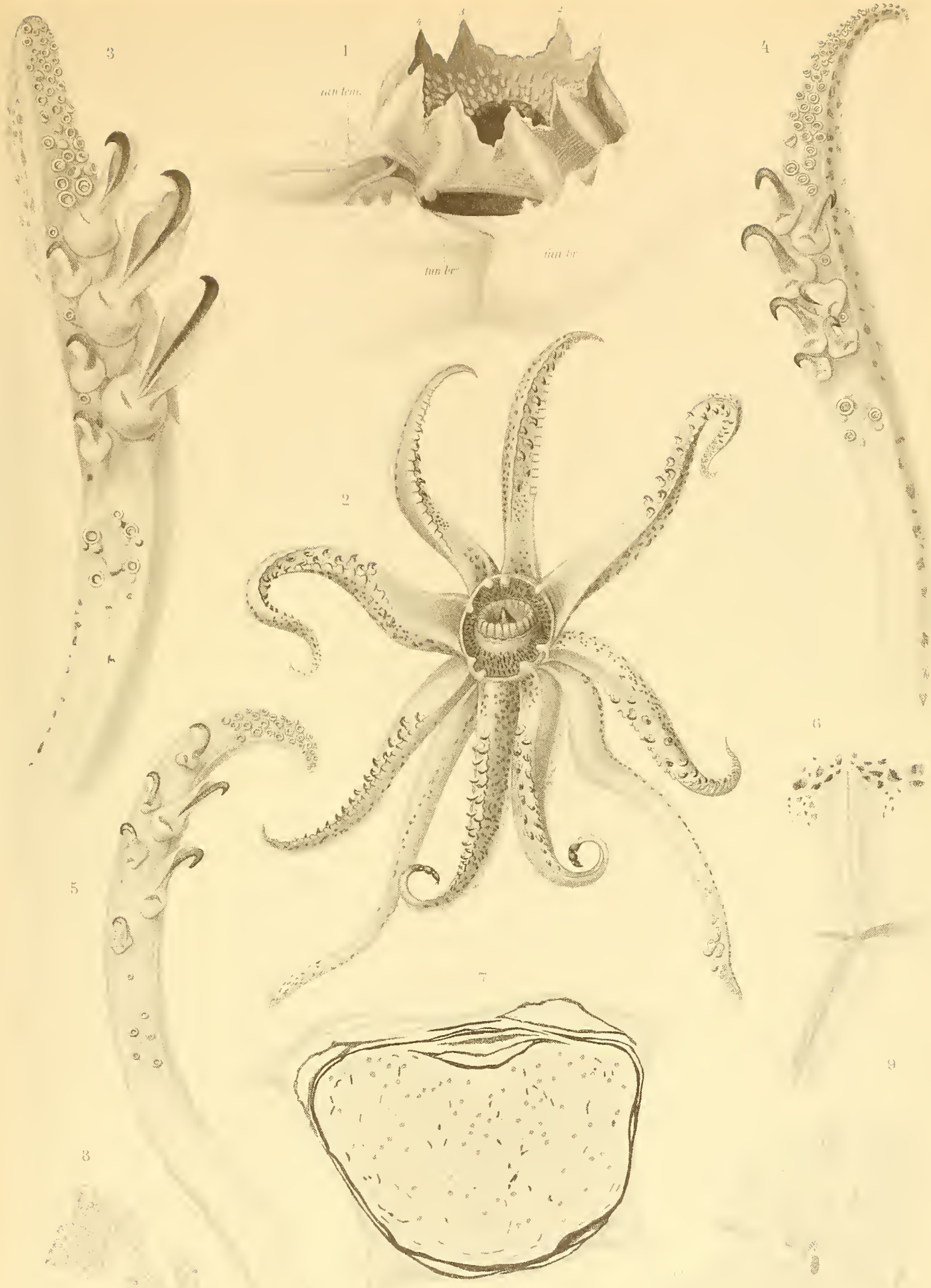
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Plate IX

Abraliopsis, *Abralia*. Mantle complex and genitalia

Figures 1–5. *Abraliopsis morisii* VÉR.

Figure 1. Opened mantle cavity of male. Spermatophore sac filled with spermatophores. Station 254, Indian Ocean. Appr. × 4

Figure 2. Opened mantle cavity of an Atlantic male with markedly swollen testes and far projecting end of spermatophore sac. Appr. × 4

Figure 3. Opened mantle cavity of large female from Station 256 (Indian Ocean), with ripe eggs and markedly swollen oviduct glands. × 4

Figure 4. Oviduct glands and adjacent organs of same female, diagonally viewed from the right. × 4

Figure 5. Male gonoducts, dorsal. Station 254, cf. Figure 1. × 9

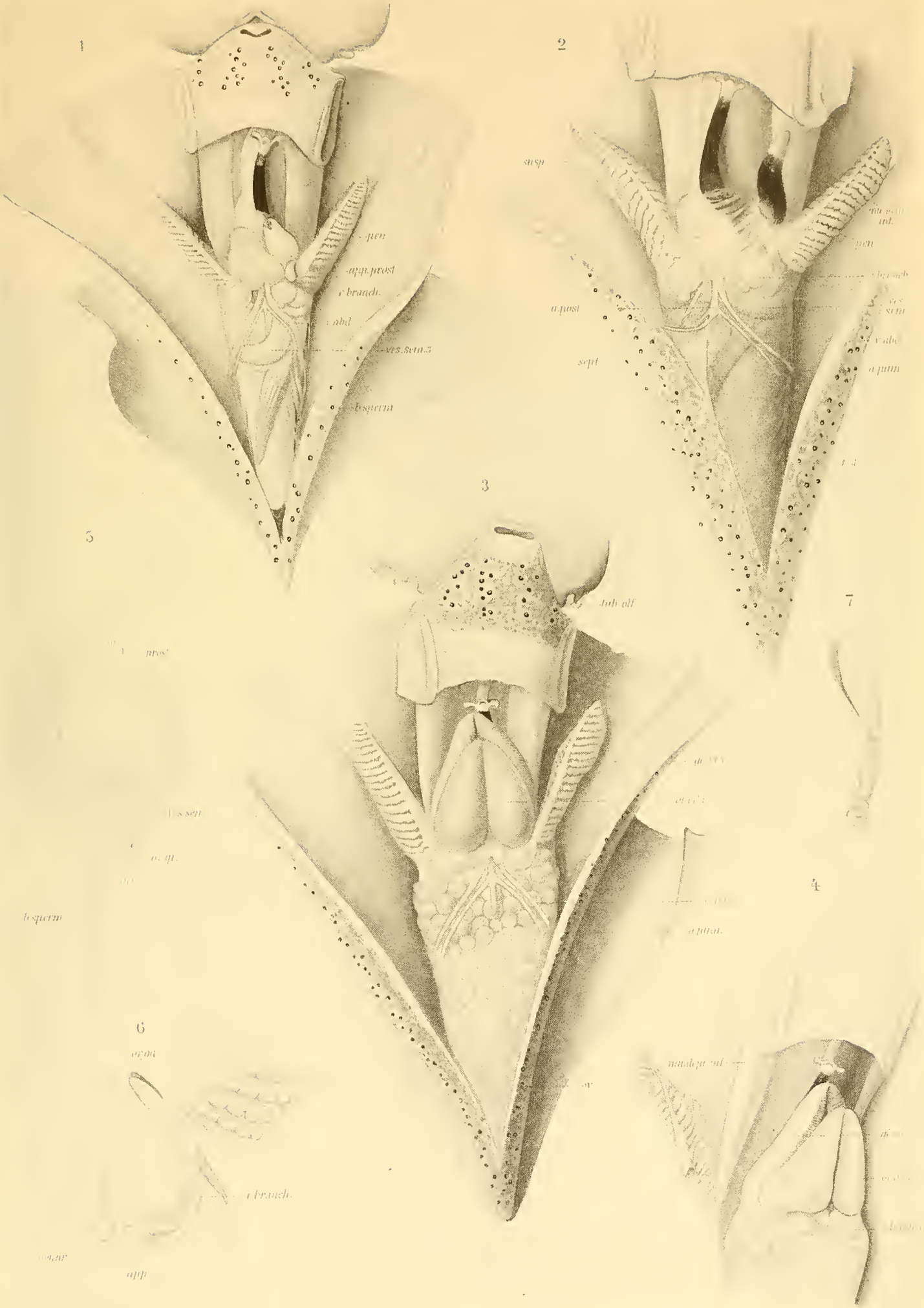
Figures 6 and 7. *Abralia owenii* VÉR.

Figure 6. Left oviduct of young female from Nice (dorsal length of mantle—22 mm), natural position, ventral

Figure 7. Same oviduct, exposed.

ABBREVIATIONS

a.—artery
a. pinn.—artery of fins
a. post.—posterior artery
amp.—opening of vas deferens
app. c.—appendage of branchial heart
app. prost.—appendage of prostate
b. sperm.—Needham's sac (spermatophore sac)
c. branch.—branchial heart
gl. od. i.—lower half of oviduct gland
gl. od. s.—upper half of oviduct gland
mu. depr. inf.—funnel depressor
nephr.—renal sac
or. od.—opening of oviduct
ov.—ovary
pen.—terminal part of spermatophore sac
prost.—prostate
sept.—mantle septum
susp.—branchial ligament
test.—testis
tub. olf.—olfactory tubercle
v.—vein
v. abd.—abdominal vein
v. def.—vas deferens
ves. sem.—seminal vesicle
ves. sem. 3—3rd part of seminal vesicle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a. punn
tub. olf
b. sperm
c. branch.
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Plate X

Abraliopsis morisii VÉR. Hectocotylus, genitalia, luminous organs

Figure 1. Hectocotylus, buccal funnel and attachment of adjacent arms, ventral. Male from Station 54. × 12
Figure 2. Male gonoducts, ventral. Specimen from Station 254
Figure 3. Gonoducts of male from Station 254, dissected out.
Figure 4. Skin with luminous organs, directly anterior to funnel. Station 256
Figure 5. Part of mantle and funnel with luminous organs. Station 256
Figure 6. Median section of a large luminous organ of the eye. Zeiss C. 2. Station 254. × 224
Figure 7. Section through fully developed organ of mantle. Station 254

ABBREVIATIONS

amp.—opening of vas deferens
app. prost.—appendage of prostate
b. sperm.—spermatophore sac (Needham's sac)
c.—central luminous cells
can. cil.—ciliated canal
cart.—cartilage of eye
chr.—chromatophores
co.—outer sheath of luminous organ
l.—bars of connective tissue
fibr.—fibers of connective tissue
l.—lens
lac.—lacuna
nu.—nuclei
or. cil.—opening of ciliated canal
phot.—lūminous body
prost.—prostate
refl.[1]—cuppola of reflector
refl.[2]—lateral parts of reflector
str.—fibrous cells of eye organ
v.—vessel
v. def.—vas deferens
v. eff.—vas efferens
ves. sem. 1, 2, 3—1st, 2nd and 3rd part of seminal vesicle

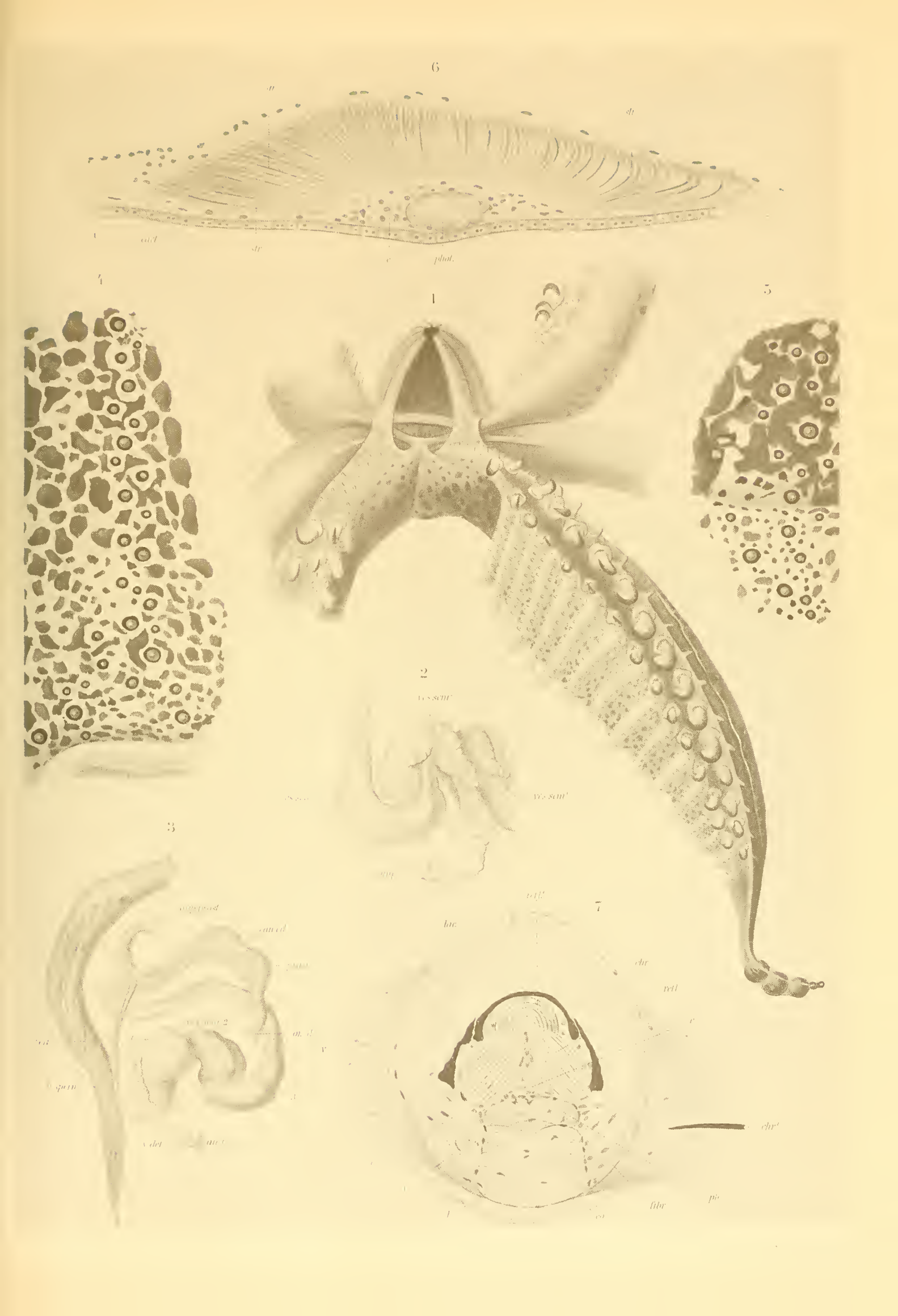
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Plate XI

Figures 1–4. *Pyroteuthis margaritifera* VÉR.

Figure 1. Male from Messina. Ventral view with ventral luminous organs. × 2
Figure 2. Hectocotylus with large lobes, lateral. Appr. × 6
Figure 3. Same, inner side. Appr. × 6
Figure 4. Right tentacle of female. Appr. × 18

Figures 5 and 6. *Enoploteuthis leptura* D'ORB.

Figure 5. Young male from Atlantic South Equatorial Current. × 2.5
Figure 6. Tentacle club. Appr. × 12.

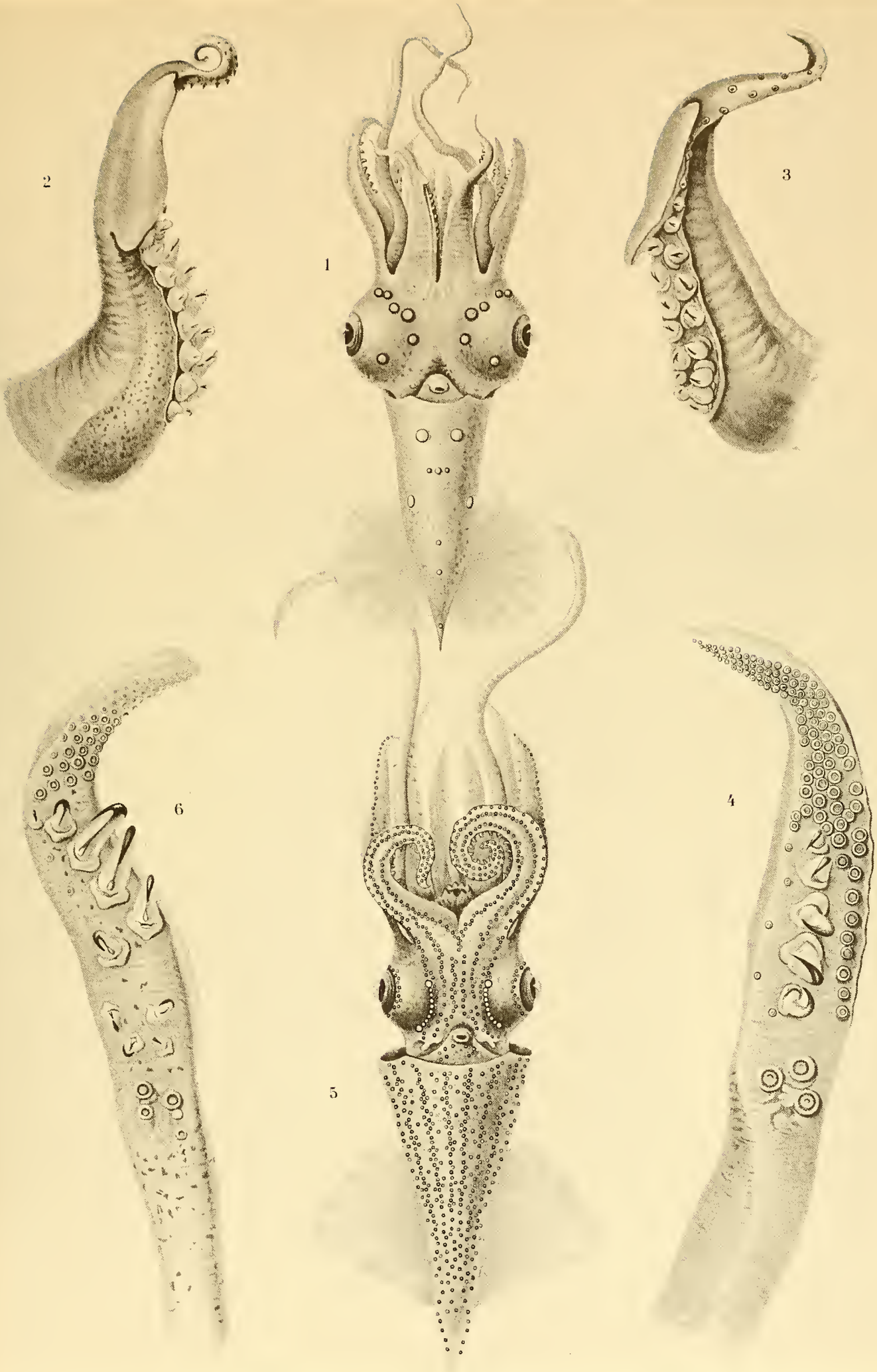
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Plate XII

Pterygioteuthis giardi FISCHER. Males and juvenile forms

Figure 1. Medium-sized male from Station 217, Indian North Equatorial Current. Dorsal view. Color sketch of live animal. × 5

Figure 2. Same, ventral.

Figure 3. Small male from Station 215, Indian North Equatorial Current. Right side. Color sketch of live animal. × 5.5

Figure 4. Same, ventral.

Figure 5. Older juvenile stage from Station 117, Agulhas Current. Ventral

Figure 6. Older juvenile stage from Station 66, South Equatorial Current. Ventral. × 7.5

Figure 7. Larva from South Equatorial Current. Ventral. × 7.5

Figure 8. Larva from South Atlantic. Ventral

Figure 9. Larva from Atlantic South Equatorial Current. Dorsal. × 7.5

Figure 10. Same, ventral.

Figure 11. Same, left side.

Figure 12. Larva from Station 231, Indian Countercurrent. Left side. × 7.3

Figure 13. Youngest larva from South Atlantic. Right side. × 7.3

Figure 14. Youngest larva from Station 214, Indian North Equatorial Current. Left side. × 7.3

Figure 15. Same larva, ventral diagonal. × 25

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Plate XIII

Pterygioteuthis, arm apparatus and buccal funnel; larvae of Enoploteuthidae

Figure 1. *Pterygioteuthis giardi*. Young male from Indian North Equatorial Current, Station 217 (Plate XII, Figures 1, 2). Buccal funnel, ventral. Ventral arms bent downward, their attachment cut. × 8

Figure 2. Same specimen, arms and buccal funnel dissected out. Appr. × 8

Figure 3. *Pt. gemmata*, female. Attachment of ventral arms and tentacle, left side. The thin, long muscle of attachment of the tentacle passes below the deep attachment of the 3rd arm to the base of the tentacle. Porus aquiferus present between chocolate-brown buccal funnel and deep attachment

Figure 4. Tentacle club of young male of *Pt. giardi* from Station 217 (Plate XII, Figures 1, 2)

Figure 5. *Pt. giardi*. Young male from Station 215. Sail-shaped connection of dorsal arms seen from the outside

Figure 6. *Pyroteuthis margaritifera*, female. Attachment between 2nd and 3rd arm on the right side

Figure 7. *Pterygioteuthis giardi*. Young male from Station 215. Buccal funnel viewed from the ventral diagonal. Ventral arms (not drawn) bent down

Figure 8. *Pt. giardi*. Neck cartilage of male from Station 217.

Figures 9–12. Larvae of *Pterygioteuthis*

Figure 9. Tentacle of youngest larva from Station 214 (Plate XII, Figure 14), anterior and lateral. Appr. × 50

Figure 10. Posterior end of body of same larva, dorsal.

Figure 11. Tentacle of larva from Station 231 (Plate XII, Figure 12).

Figure 12. Tentacle of larva from Station 46 (Plate XII, Figure 13).

Figures 13–23. Larvae of Enoploteuthidae

Figure 13. Larva from southern part of Benguela Current. Station 91. × 6

Figure 14. Left tentacle club of same larva. × 30

Figure 15. Younger larva from Station 91, southern part of Benguela Current. × 10

Figure 16. Tentacle club of same larva. Appr. × 20

Figure 17. Young larva from Station 102, Agulhas Bank. × 10

Figure 18. Tentacle club of same larva. Appr. × 30

Figure 19. Younger larva, same stage as in Figure 17, ventral. Station 102, Agulhas Bank. × 10

Figure 20. Younger larva, same stage, lateral. Station 102, Agulhas Bank. × 10

Figure 21. Tentacle club of same larva. Appr. × 30

Figure 22. Youngest larva from Station 102, Agulhas Bank.

Figure 23. Arm apparatus of same larva.

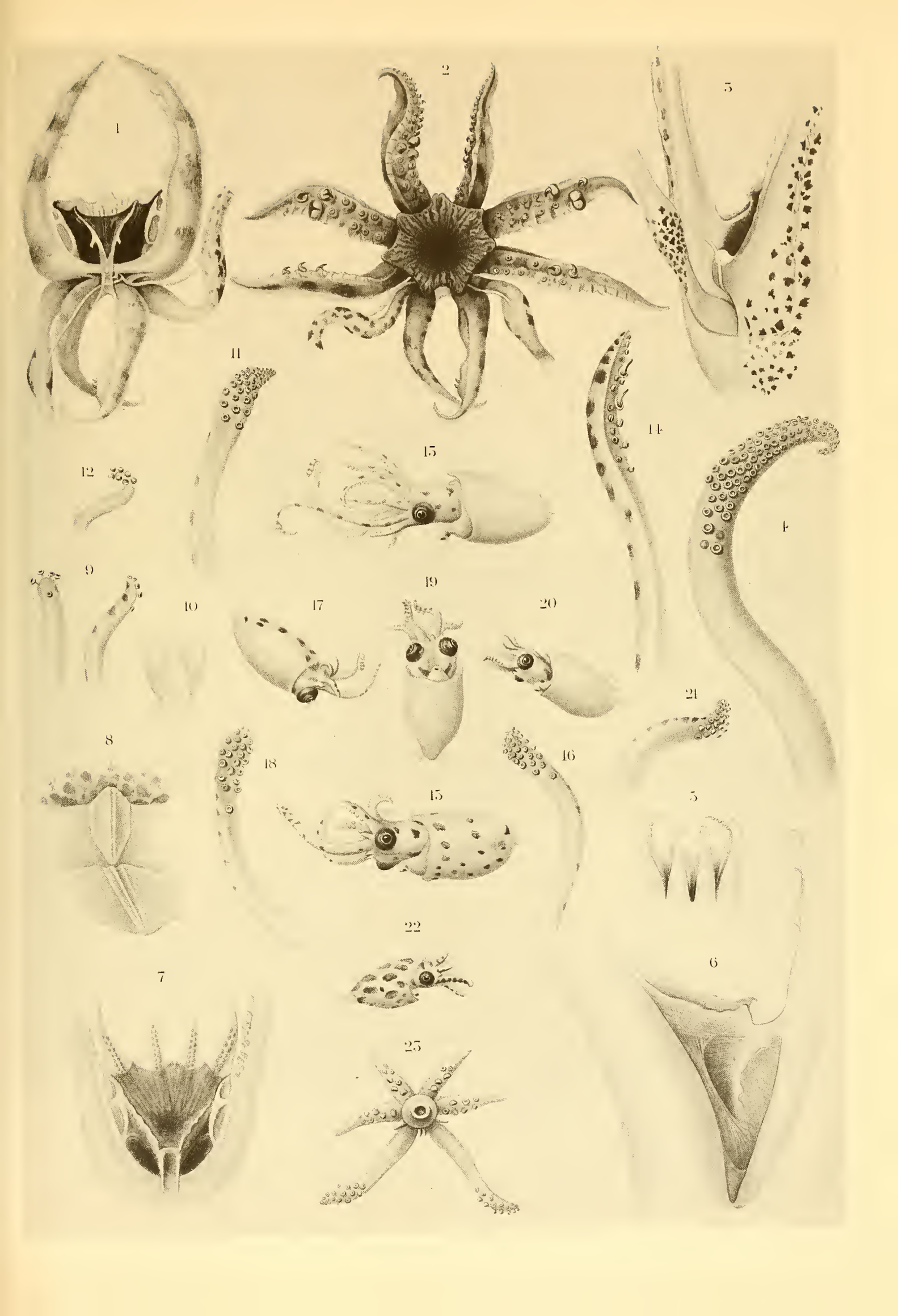
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Plate XIV

Pterygioteuthis. Arrangement of luminous organs

Figure 1. Adult of *Pterygioteuthis giardi* with opened mantle cavity. Station 218, Indian North Equatorial Current. × 5.2

Figure 2. Slightly younger male of *Pt. giardi* from Indian North Equatorial Current, Station 217 (Plate XII, Figure 11. Mantle cavity and funnel opened. × 6

Figure 3. Young male of *Pt. giardi* from Indian North Equatorial Current (Plate XII, Figure 4). Abdominal wall opened to show testis. ♂—male gonoducts

Figure 4. Mantle organs of male of *Pt. gemmata*.
Drawn after a specimen fixed in formol by VANHÖFFEN. North of Tristan da Cunha

Figure 5. Eye organs of female of *Pt. gemmata*. Right eye. Eyeball turned slightly down, so that organ No. 10 is not visible

Figure 6. Eye organs of adult male of *Pt. giardi* (Figure 1). Right eye

Figure 7. Eye organ No. 10 of *Pt. giardi*, exterior surface, with pigment cup and lens.

Figure 8. Eye organs of *Pyroteuthis margaritifera* (Messina). Left eye turned slightly outward to show the small organs

Figure 9. Left anal organ of male of *Pt. gemmata* (cf. Figure 4). Lateral view

ABBREVIATIONS

an. – anus
app. prost.—appendage of prostate
luc. an.—anal organ
luc. branch.—branchial organ
l. br.—dto.
luc. v. 1.—first ventral organ
luc. v. 2—2nd ventral organ
luc. v. 3—3rd ventral organ
luc. v. 4—4th ventral organ
pen.—terminus of spermatophore sac
ur.—papilla or renal sac
v. abd.—abdominal vein

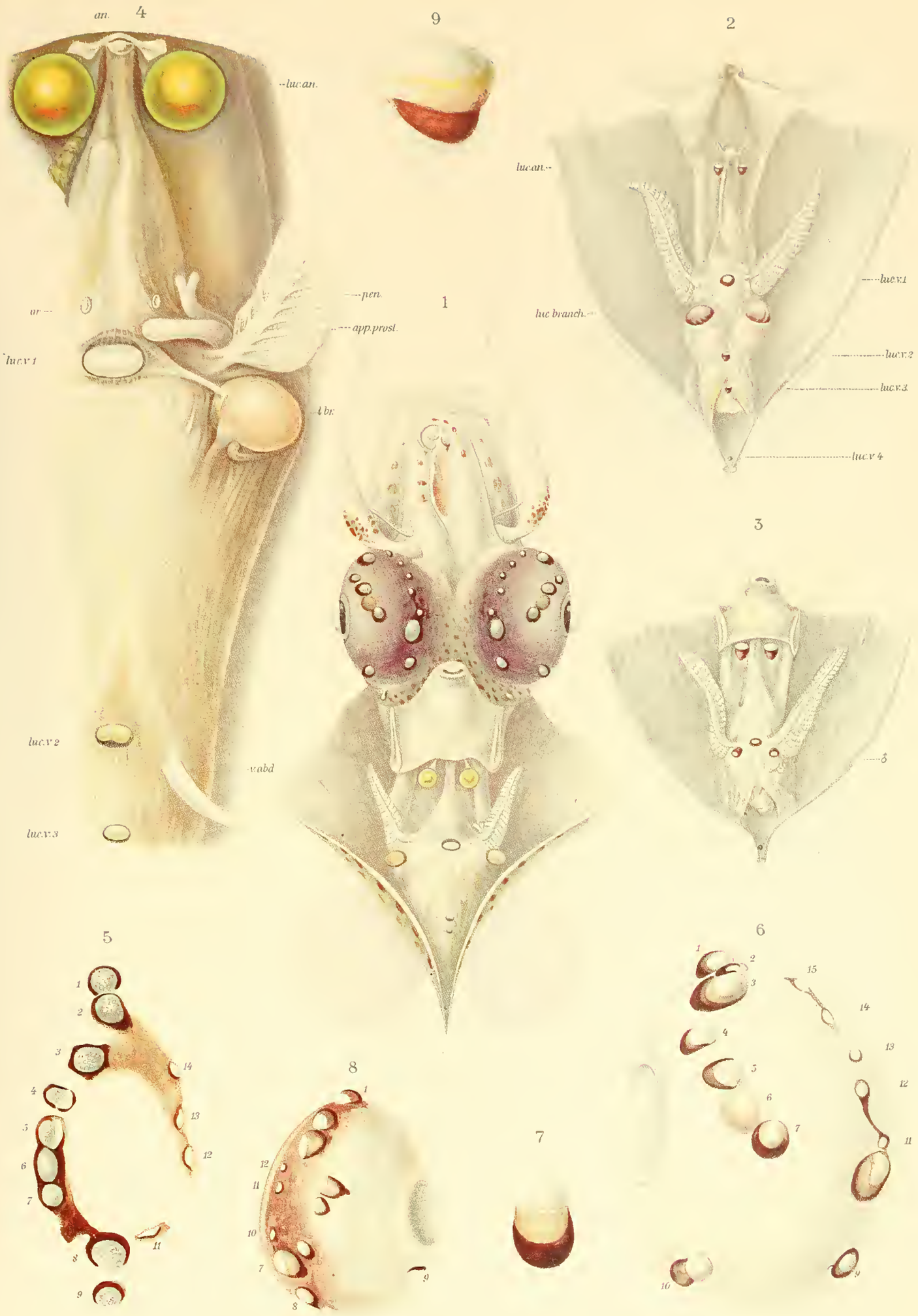

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Plate XV

Pterygioteuthis. Hectocotylus and genitalia

Figure 1. Hectocotylus of adult male of *Pterygioteuthis giardi*, inner surface (cf. Plate XIV, Figure 1)

Figure 2. Hectocotylus of adult male of *Pt. gemmata* n.sp. Surface facing median plane

Figure 3. Same hectocotylus of *Pt. gemmata*, inner surface.

Figure 4. Tooth plate and lamellar region of the gland of the hectocotylus of *Pt. giardi* shown in Figure 1, outer surface.

Figure 5. Tooth plate and lamellar region of gland of younger male of *Pt. giardi* (Plate XII, Figure 2). Hectocotylus, outer side

Figure 6. Longitudinal section of distal half of hectocotylus and glandular swelling of *Pt. gemmata*. Hemalum. Zeiss A. 0

Figure 7. Cross section through hectocotylus of *Pt. gemmata* between the two glandular swellings. Hemalum. Zeiss A. 0

Figure 8. Cross section through hectocotylus of *Pt. gemmata* at level of proximal glandular swelling. Hemalum. Zeiss A. 0

Figure 9. Male genitalia of *Pt. gemmata*.

Figure 10. Ciliated funnel of ciliated canal of *Pt. gemmata*, longitudinal section. Formol-alcohol. Iron-hematoxylin. Zeiss F. 0

Figure 11. Slightly oblique transverse section of end of ciliated duct of *Pt. gemmata*. Iron-hematoxylin. Zeiss F. 0

Figure 12. Gland cells of first part of seminal vesicle of *Pt. gemmata*. Formol-alcohol. Hemalum. Zeiss F. 2

ABBREVIATIONS

amp.—opening of vas deferens in body cavity
app. prost.—appendage of distal vas deferens
b. sperm.—spermatophore sac (Needham's sac)
can. cil.—ciliated canal
gl.—glandular sacs of hectocotylus
gl. dist.—distal glandular pad
gl. prox.—proximal glandular pad
gl. str.—glandular grooves of hectocotylus
lam. dent.—toothed lamella of hectocotylus
lam. nat.—swimming membrane
m. brach.—arm musculature
n.—arm nerve
n'.—lateral branches of arm nerve
or. cil.—ciliated funnel of ciliated canal
or. gl.—opening of glandular sac
prost.—accessory gland (prostate)
v. d.—vas deferens
v. eff.—vas efferens
ves. sem. 1—1st part of seminal vesicle (spermatophore gland)
ves. sem. 2—2nd part of spermatophore gland
vas. sem. 3—3rd part of spermatophore gland
α, β, γ—the 3 subdivisions of the 3rd part

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Plate XVI

Luminous organs of *Pterygioteuthis*

Preparations were made from specimens fixed in formol. All outlines were drawn using prism

Figure 1. *Pt. gemmata*, male. Section of eye organ No. 1. Hemalum. × 135
Figure 2. *Pt. gemmata*, male. Organ No. 10. × 133
Figure 3. *Pt. giardi*, Station 217. Median section of organ No. 10. Hemalum
Figure 4. *Pt. giardi*, male. Station 218. Organ No. 10. × 53
Figure 5. *Pt. gemmata*, male. Organ No. 6. × 133
Figure 6. *Pt. giardi*, male. Organ No. 6. × 53
Figure 7. *Pt. gemmata*, male. Organ No. 6. × 53
Figure 8. *Pt. gemmata*, male. Small organ No. 11, with lens. × 133
Figure 9. *Pt. gemmata*, male. Small organ No. 12. × 133
Figure 10. *Pt. gemmata*, male. Large anterior abdominal organ. Iron-hematoxylin. Section is transverse to longitudinal axis of body. × 133
Figure 11. *Pt. gemmata*, male. Second abdominal organ. Median section. × 133
Figure 12. *Pt. gemmata*, male. Left anal organ. Hemalum. × 133
Figure 13. *Pt. gemmata*, male. Median section of the right branchial organ. Hemalum. × 133
Figure 14. *Pt. gemmata*. Part of luminous body of right branchial organ. Zeiss, homog. immersion
Figure 15. *Pt. gemmata*. Part of eye organ No. 3; lamella of inner reflector with nerves and vessels penetrating the lamella. Zeiss F. 0
Figure 16. *Pt. gemmata*. Squamous cell from eye organ No. 3, surface view
Figure 17. *Pt. gemmata*, female. Large anterior eye organ. Fixed in sublimate: nerves entering luminous body stained black with iron-hematoxylin. Zeiss, homog. immersion
Figure 18. Same object as in Figure 17. Bundle with 3 nerve fibers radiating into it
Figure 19. Part of branchial organ of *Pt. gemmata*; nerve bundles entering luminous body.

ABBREVIATIONS

cap.—capillaries
cart.—cartilage of eye
coll.—marginal lamellae of anal organ
cps.—outer sheath of ventral organs
fibr.—layer of connective tissue
l.—lens
l.'—granulate cells of lens of eye organs
l.''—homogeneous cells of lens of eye organs
l.sq.—squamous cells of lens
lam.—system of lamellae
lam.l.—lateral system of lamellae
lam.ext.—outer system of lamellae
lam.int.—inner system of lamellae
n.—nerves
n.[1]—nerve layer of branchial organ
nu.l.—nuclei of lens cells
nu.lam.—nuclei of lamellae
mu.—muscle fibers
mu.l.—longitudinal muscles
pg.—pigment
phot.—luminous body
phot.[1]—luminous body of the double organ
refl.—reflector
sq.—squamous cells
sq.int.—inner squamous cells
str.—fibers of lens
v.—vessel
ven.—vein

Plate XVII

Octopodoteuthis RÜPPELL (*Veranya* KROHN). Larvae from Indian Ocean

Figure 1. Oldest larva. Station 271, Gulf of Aden. Ventral. × 6
Figure 2. Same larva, dorsal.
Figure 3. Larva from Station 102, Agulhas Current. Ventral. × 6
Figure 4. Same larva, dorsal. × 6
Figure 5. Younger larva from Station 102, Agulhas Current. Anterior region, ventral. Appr. × 28
Figure 6. Same larva. Anterior region, dorsal. Appr. × 28
Figure 7. Tentacle club of oldest larva. Lateral. Appr. × 40
Figure 8. Same club, broad side. Appr. × 40
Figure 9. Arm apparatus of larva from Station 102 (cf. Figure 3).
Figure 10. Arm- and buccal apparatus of oldest larva from Station 271 (cf. Figure 1).
Figure 11. Anterior region of youngest larva. Station 215. Indian North Equatorial Current. Appr. × 32
Figure 12. Tentacle club of youngest larva. Station 215. Appr. × 90

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Plate XVIII

Calliteuthis, *Histioteuthis* juv.

Figure 1. *Calliteuthis hoylei* GOODRICH. Station 235, Indian South Equatorial Current near the Amirantes. Ventral. × 2
Color sketch of the live animal.

Figures 2, 3, 4. *Calliteuthis reversa*. Station 223, Indian Countercurrent near Chagos Archipelago
Color sketch of the live animal.

Figure 2. Dorsal. × 2

Figure 3. Ventral. × 2

Figure 4. Left side. × 2

Figure 5. *Calliteuthis*. Juvenile form from Station 112, southern part of Aqulhas Bank. Ventral. × 8

Figure 6. *Histioteuthis*. Juvenile form. Deepwater catch near Villefranche. Right side. × 7

Figure 7. Same, ventral. × 7

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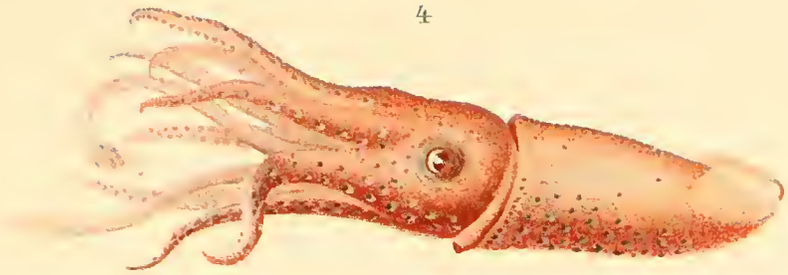

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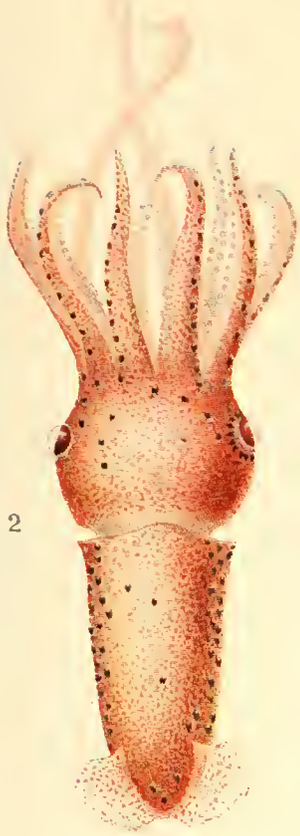

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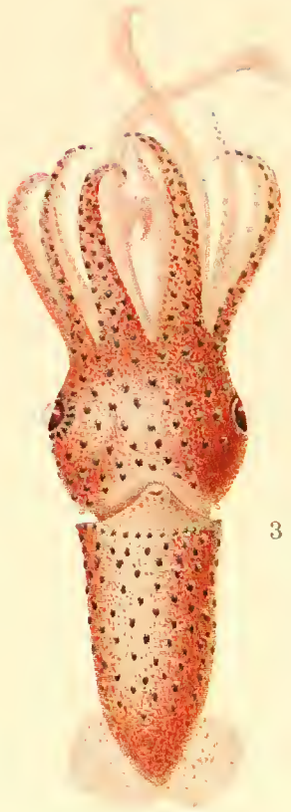

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Plate XIX

Histioteuthis juv., *Calliteuthis*

Figure 1. Juvenile form of *Histioteuthis*, ventral. Messina. Appr. × 7
Figure 2. Right club of same specimen. Appr. × 20
Figure 3. Juvenile form of *Histioteuthis*, left side. Station 73, Benguela Current. Appr. × 8
Figure 4. Right club of same specimen.
Figure 5. Right club of *Calliteuthis reversa*. Station 223 (cf. Plate XVIII, Figures 2–4). Appr. × 16
Figure 6. Right club of *Calliteuthis hoylei*. Station 235 (cf. Plate XVIII, Figure 1). Appr. × 16

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Plate XX

Anatomy of *Calliteuthis*

Figure 1. *Calliteuthis hoylei.* Station 235. Left eye, lateral. × 6
Figure 2. *C. hoylei.* Station 235. Neck cartilage. × 8
Figure 3. *C. reversa.* Station 223. Buccal funnel and attachment. × 4
Figure 4. *C. reversa.* Station 223. Neck cartilage. × 8
Figure 5. *C. hoylei.* Station 235, young female. Mantle complex. × 7
Figure 6. *C. reversa.* Station 223, young female. Mantle complex. Appr. × 4
Figure 7. *C. ocellata.* Sagami Bay (Japan). The double genitalia of the mature male. Natural size
Figure 8. *C. ocellata.* Sagami Bay. Spermatophore
Figure 9. *C. ocellata.* Oral end of spermatophore tube
Figure 10. *C. hoylei.* Anal appendage. × 30
Figure 11. *C. reversa.* Anal appendage. × 30
Figure 12. *C. hoylei.* Longitudinal section of luminous organ. Formol-alcohol. Hemalum
Figure 13. *C. reversa.* Squamous cell of reflector, surface view. Formol-alcohol; homog. imm. 1/12
Figure 14. *C. reversa.* Luminous cells; homog. imm. 1/12

ABBREVIATIONS

a. pall.—pallial artery
a. pinn.—artery of fins
a. post.—posterior artery
amp.—opening of vas deferens
app. prost.—appendage of prostate
b. sperm. d.—right spermatophore sac
b. sperm. s.—left spermatophore sac
c. alb.—white body
c. branch.—branchial heart
c. cil. s.—left ciliated canal
c. sq.—squamous cells
chr.—chromatophores
cil.—ciliated body
coll.—swelling substance
fil.—terminal filament
g. opt.—optic ganglion
glut.—adhesive pad
inf.—ciliated funnel
l.—lens
l'.—inner fibers of lens
mu. depr. inf.—funnel depressor
n.—nerve
nid.—nidamental gland
od.—oviduct
or.—opening of projectile tube
pg.—pigment
proj.—projectile tube
prost. d.—right prostate
prost. s.—left prostate
refl.—reflector
sacc. ven.—venous sac
sp.—sperm
spec.—mirror
spec.'—mirror of posterior organ
sperm.—spermatophores
stom.—stomach
test.—testis
ur.—papilla of renal sac
v. abd.—abdominal vein
v. def. d.—right vas deferens
v. def. s.—left vas deferens
ves. sem. 1—1st part of seminal vesicle
ves. sem. 2—2nd part of seminal vesicle
ves. sem. 3—3rd part of seminal vesicle
x—cord of connective tissue

Plate XXI

Histioteuthis rüppellii VÉRANY

Large male from Nice with both dorsal arms hectocotylized. Two-thirds natural size

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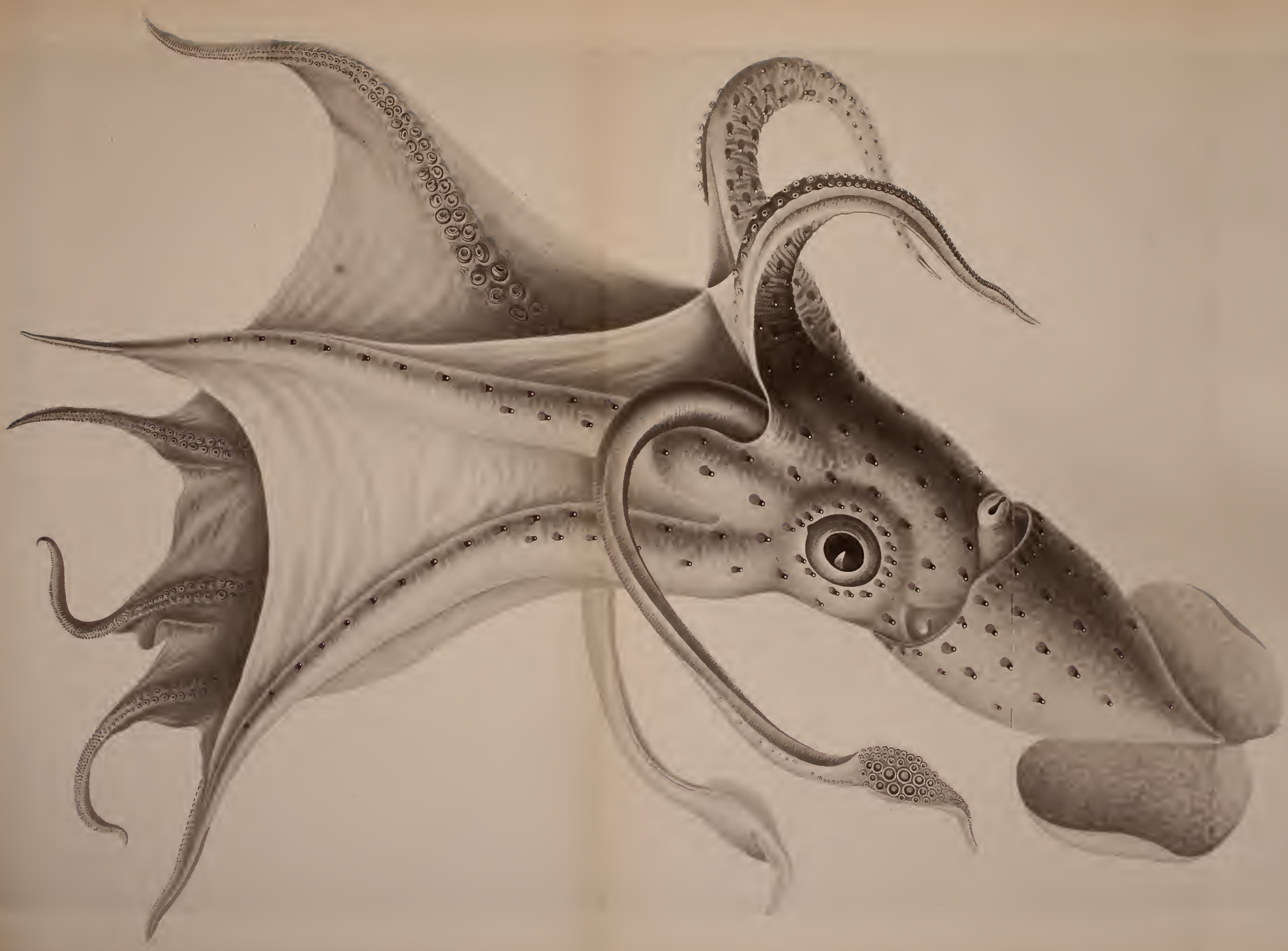
Plate XXII

Teleoteuthis caribaea LESUEUR

Juvenile stages from Station 49, Atlantic South Equatorial Current, surface

Figure 1. Youngest stage, ventral. × 4
Figure 2. Same stage, dorsal. × 4
Figure 3. Slightly older stage, dorsal. × 4
Figure 4. Same, ventral.
Figure 5. Intermediate stage, dorsal. × 4
Figure 6. Same, ventral. × 4
Figure 7. Oldest stage, dorsal. × 3
Figure 8. Same, ventral. × 3



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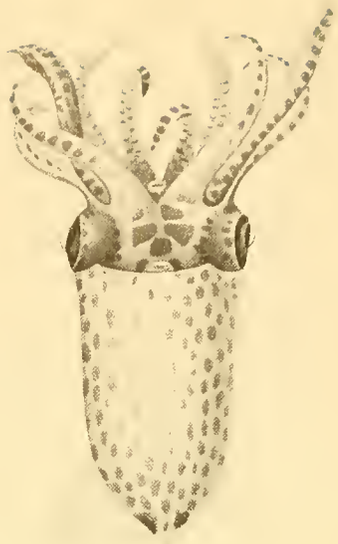

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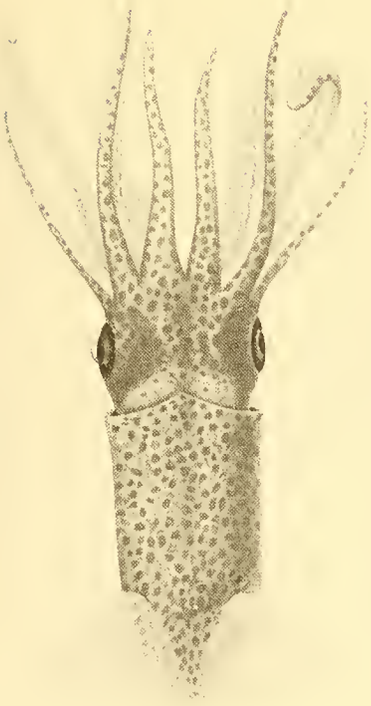

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Plate XXIII

Larvae of Onychoteuthidae, clubs of *Teleoteuthis caribaea*

Figure 1. Youngest larva, right side. Station 218, Bay of Bengal. × 10
Figure 2. Arms of same larva, seen from above.
Figure 3. Young larva, right side. Station 172, southern part of Indian Ocean. × 10
Figure 4. Arms of same larva.
Figure 5. Young larva, left side. Station 48, Atlantic South Equatorial Current. × 10
Figure 6. Arms of same larva.
Figure 7. Older larva, left side. Station 218, Bay of Bengal. × 10
Figure 8. Arms of same larva.
Figure 9. Oldest larva, left side. Station 74, Benguela Current. × 10
Figure 10. Arms of same larva.

Figures 11–14. Clubs of juvenile stages of *Teleoteuthis caribaea*. Station 49

Figure 11. Club of youngest stage (cf. Plate XXII, Figures 1, 2). Appr. × 30
Figure 12. Club of young stage (cf. Plate XXII, Figures 3, 4). Appr. × 30
Figure 13. Club of intermediate stage (cf. Plate XXII, Figures 5, 6). Appr. × 18
Figure 14. Club of oldest stage (cf. Plate XXII, Figures 7, 8). Appr. × 18

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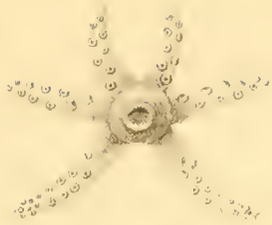

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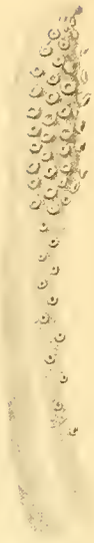

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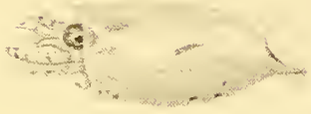

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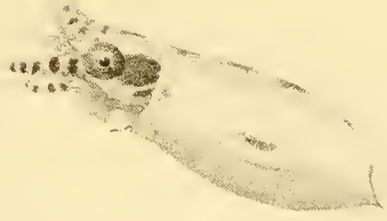

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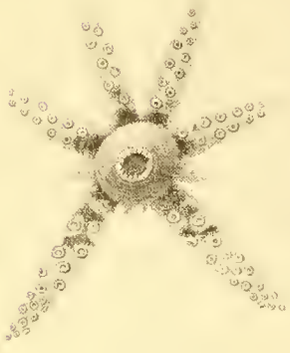

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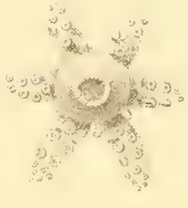

Plate XXIV

Benthoteuthis megalops VERRILL (*Bathyteuthis abyssicola* HOYLE)

Based on color sketches of live animals

Figure 1. Largest specimen, dorsal. Station 221, Indian Countercurrent near Chagos Archipelago. × 3

Figure 2. Same specimen, ventral. × 3

Figure 3. Medium-sized specimen, dorsal. Station 217, Indian North Equatorial Current. × 3

Figure 4. Medium-sized specimen, ventral. Station 115, Benguela Current South of Cape of Good Hope. × 3

Figure 5. Same, right side. × 3

Figure 6. Small specimen, left side. Station 207, Indian Ocean (Surat passage). × 3

Figure 7. Head of medium-sized specimen, ventral. × 6

Figure 8. Head of same specimen, obliquely from left side. × 6

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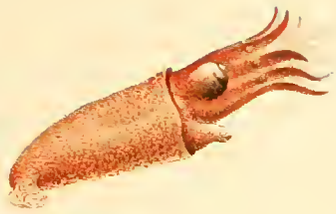

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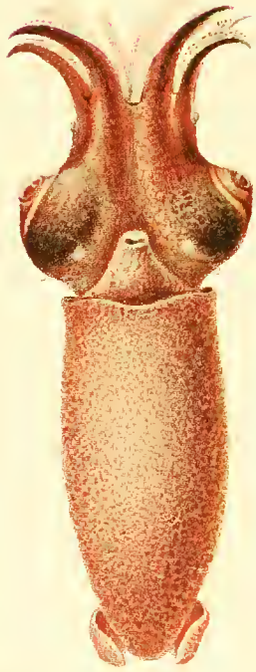

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Plate XXV

Benthoteuthis megalops VERRILL. Arm apparatus, mantle complex

Figure 1. Mantle complex of large specimen, Station 221. Appr. × 4
Figure 2. Arm apparatus, diagonally dorsal. Small specimen, Station 115. Appr. × 15
Figure 3. Arm apparatus, diagonally ventral. Large specimen, Station 221
Figure 4. Club of the large specimen from Station 221. Appr. × 30
Figure 5. Club of small specimen from Station 115. Appr. × 30
Figure 6. Funnel organ of the large specimen from Station 221. × 8
Figure 7. Neck cartilage of same specimen. Appr. × 10

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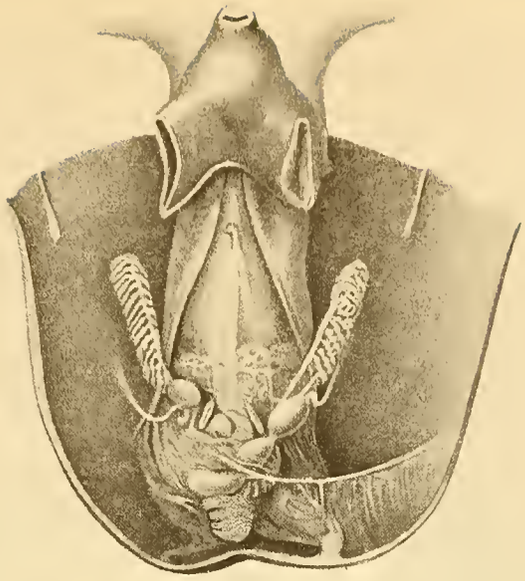

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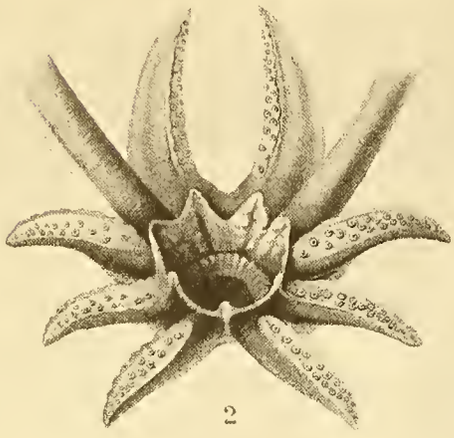

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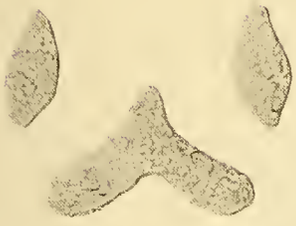

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Plate XXVI

Benthoteuthis megalops VERRILL. Intestinal tract, vascular system. Large specimen from Station 221

Figure 1. Mantle complex, ventral. Abdominal wall with heart and vessels removed. × 10
Figure 2. Intestinal tract, left side. × 10
Figure 3. Intestinal tract, dorsal. × 10
Figure 4. Mantle complex with intestinal tract, vascular system, and female genitalia, ventral. × 10
Figure 5. Vascular system, nidamental glands and oviduct, dorsal. × 10

ABBREVIATIONS

a. branch.—branchial artery
a. ceph.—cephalic aorta
a. post.—posterior aorta
an.—anus
ao.—cephalic aorta
app. c.—appendage or branchial heart
atr.—ink sac
branch.—gill
c.—heart
c. branch.—branchial heart
d. coel.—coelomic duct to renal sac
d. hep.—hepatic duct
hep.—liver
hep.[1]—anterior part of liver
lig. an.—anal ligament
lig. g. g.—gastro-genital ligament
mu. depr. inf.—funnel depressor
mu. retr. cap. lat.—musculus retractor capitis lateralis
nephr.—renal sac
nid.—nidamental gland
od. s.—left oviduct
oes.—esophagus
o. st.—opening of stomach
ov.—ovary
ovid.—oviduct
pancr. d.—right pancreas
pancr. s.—left pancreas
rect.—rectum
s. ven.—venous sac
s. ven. hep.—venous sac of liver
saliv. post.—posterior salivary gland
st.—stomach
st.[1]—anterior part of stomach
st. coec.—caecum
ur.—papilla of renal sac
v. abd.—abdominal vein
v. branch.—branchial vein
v. c.—vena cava
v. hep.—hepatic vein
v. hep. pancr.—hepato-pancreatic vein
v. pall.—pallial vein

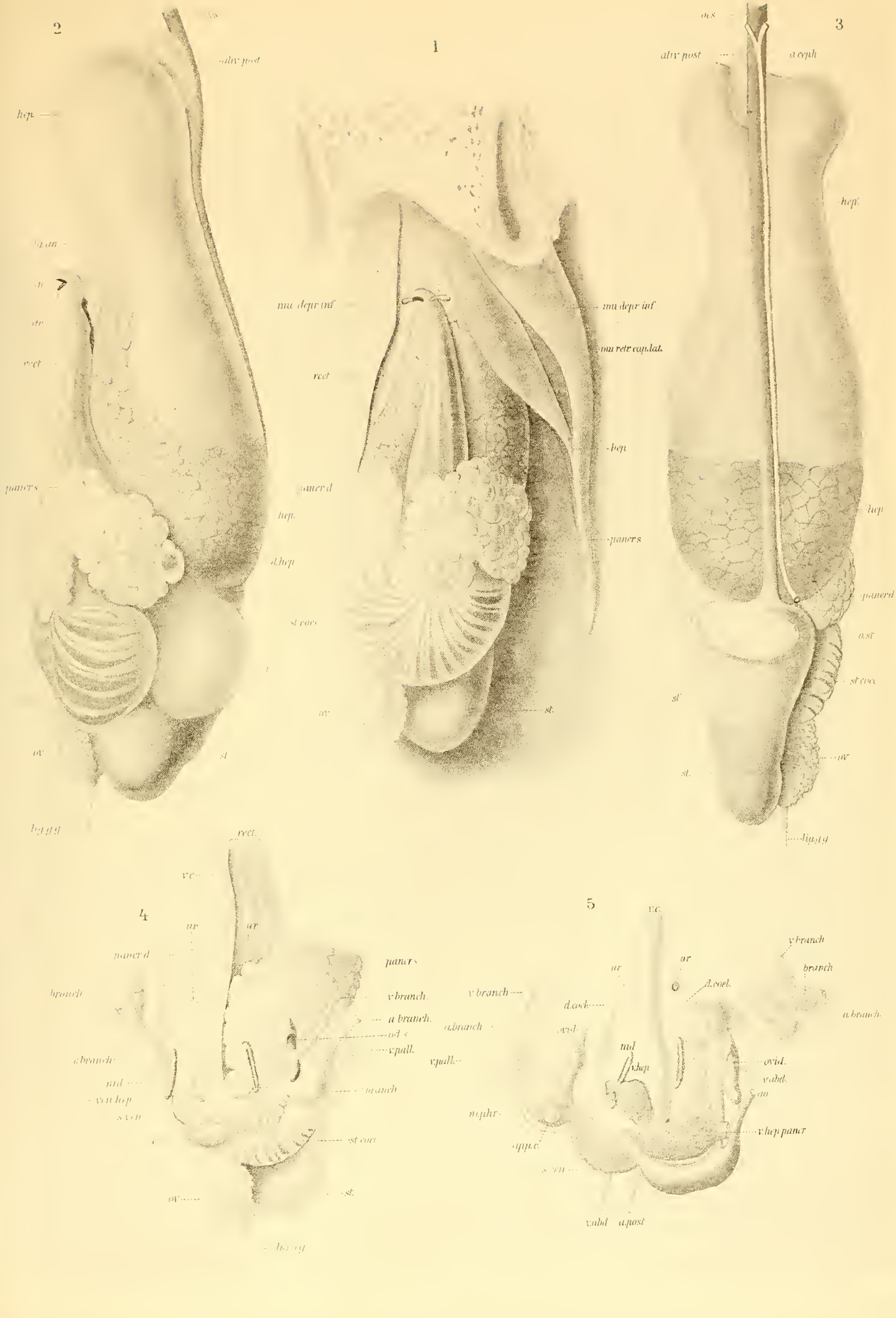
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Plate XXVII

Figures 1–8. *Benthoteuthis megalops* VERRILL. Eye and luminous organ
Fixation in formol (eye) and osmic acid (lum. organ)

Figures 9–11. *Ctenopteryx* juv.

Figure 1. Left eye of large specimen of *Benthoteuthis megalops* from Station 221. Right side. Appr. × 12
Figure 2. Same, ventral. Appr. × 12
Figure 3. Median section through eye of large specimen from Station 221.
Figure 4. Section through fovea of same eye. × 195
Figure 5. Posterior margin and fovea of same eye after clearing in oil of cloves. × 23
Figure 6. Marginal part of retina of same eye. × 195
Figure 7. Vascular whorl near fovea.
Figure 8. Longitudinal section of luminous organ of a medium-sized specimen. × 400
Figure 9. Juvenile form of *Ctenopteryx* sp., dorsal. South Atlantic Benguela Current. Station 86. × 6
Figure 10. Same, ventral × 6
Figure 11. Right fin of same specimen, lateral. Appr. × 25

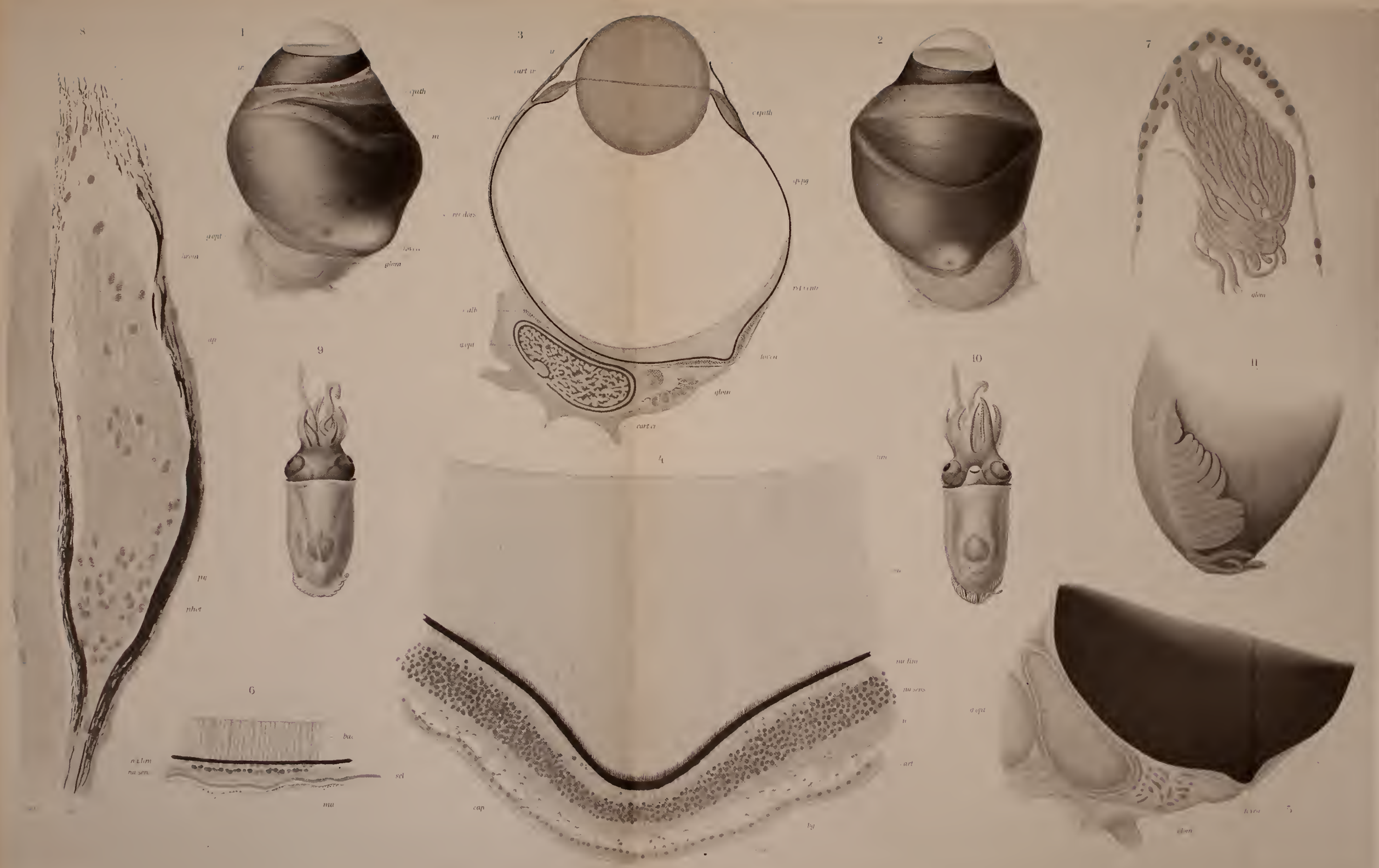
ABBREVIATIONS

bac.—rods
bg.—connective tissue
c. alb.—white body
c. epith.—epithelial (ciliated) body
cap.—capillaries
cart.—cartilage of eye
cart. cr.—cartilage of cranium
cart. ir.—cartilage of iris
chrom.—chromatophores
ep. pg.—pigmented epithelium
fovea—fovea of retina
g. opt.—optio ganglion
glom.—glomerulus
ir.—iris
lim.—membrana limitans of rod layer
m.—margin of retina
mu.—muscle fibers
mu. l.—longitudinal muscles
n.—nerve
nu. lim.—nuclei of cells of membrana limitans
nu. sens.—nuclei of sensory cells
pg.—pigment
phot.—luminous body
ret. dors.—dorsal retina
ret. ventr.—ventral retina
scl.—sclera of eyeball

Plate XXVIII

Rhynchoteuthis, larvae of Ommatostrephidae. × 10

Figure 1. Youngest larva, ventral. Station 215, Bay of Bengal
Figure 2. Young larva, ventral. Station 64, southern Atlantic near São Tomé Island
Figure 3. Young larva, right side. Station 64
Figure 4. Intermediate larva, ventral. Station 41, Guinea Current
Figure 5. Intermediate larva, right side. Station 41, Guinea Current
Figure 6. Intermediate larva, right side. Station 236, Indian Ocean near Seychelles
Figure 7. Intermediate larva, left side. Station 173, southern Indian Ocean
Figure 8. Young larva, ventral. Station 64, Atlantic Ocean near São Tomé Island
Figure 9. Intermediate larva, ventral. Station 173, southern Indian Ocean
Figure 10. Young larva, left side. Station 125, Indian North Equatorial Current
Figure 11. Older larva, ventral. Station 175, Indian South Equatorial Current
Figure 12. Older larva, ventral. Station 90, South Atlantic Benguela Current
Figure 13. Oldest larva, left side. Station 228, Indian Countercurrent
Figure 14. Same, dorsal.
Figure 15. Same, ventral.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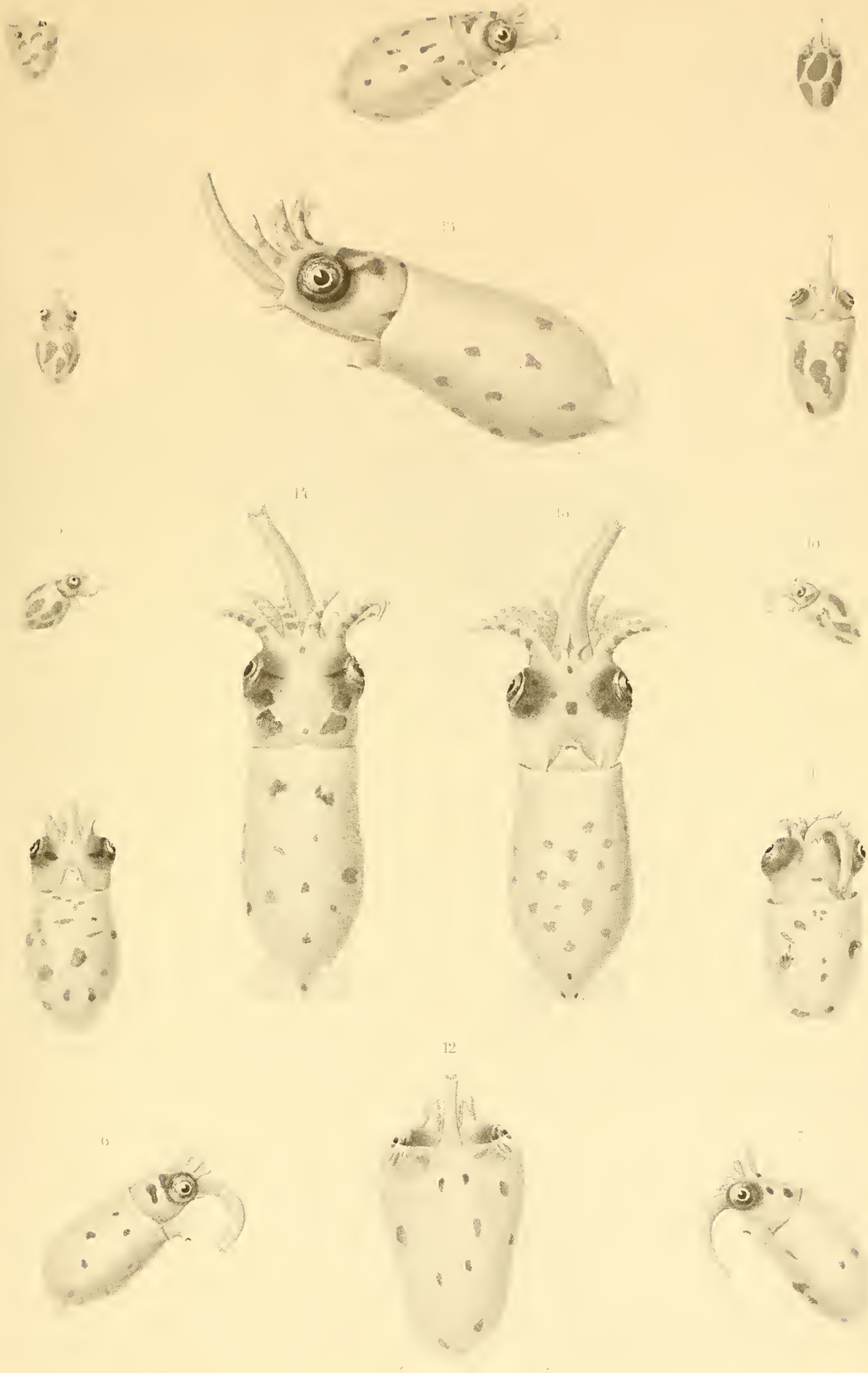

Plate XXIX

Figures 1–9. *Rhynchoteuthis*
Figures 9–11. *Brachioteuthis* (*Tracheloteuthis*)
Figures 12, 13. Larva caught in locking net

Figure 1. *Rhynchoteuthis*. Head and arms of intermediate larva, seen from above. Station 175. Appr. ×18

Figure 2. Head and arms of oldest larva (cf. Plate XXVIII, Figure 14), seen from above. Station 228. Appr. × 18

Figure 3. Neck cartilage of oldest larva. Station 228. Appr. × 20

Figure 4. Mantle complex of oldest larva. Station 228. Appr. × 20

Figure 5. Eye of young larva, lateral. Station 64

Figure 6. End of fused tentacles of young larva. Station 55, Guinea Current

Figure 7. Anal appendage of older larva. Station 90, southern Atlantic. Appr. × 50

Figure 8. Anal appendage of oldest larva. Station 228. Appr. × 50

Figure 9. *Brachioteuthis*, youngest larva, left side. Station 237. Indian South Equatorial Current. × 8

Figure 10. Head of same larva, dorsal. Appr. × 20

Figure 11. *Brachioteuthis picta* n.sp. Buccal funnel and attachment of arms, seen from above. Station 67, northern branch of Benguela Current. Appr. × 10

Figure 12. Larva caught in locking net at 1,500–2,000 m, right side. Station 120, West Wind Drift. × 10

Figure 13. Same larva, ventral. × 10

Plate XXX

Figures 1–3. *Brachioteuthis* (*Tracheloteuthis*) juv.
Figures 4, 5. *Brachioteuthis picta* n.sp.

Figure 1. Juvenile form of *Brachioteuthis*, probably belonging to *Br. riisei*. STEENSTR., left side. Station 66, northern branch of Benguela Current. × 8

Figure 2. *Brachioteuthis* juv., dorsal. Station 236, Indian South Equatorial Current near Amirantes. Appr. × 8

Figure 3. Same larva, ventral. Appr. × 8

Figure 4. *Brachioteuthis picta* n.sp., dorsal. Station 67, northern branch of Benguela Current. × 2

Figure 5. Same specimen, ventral. × 2

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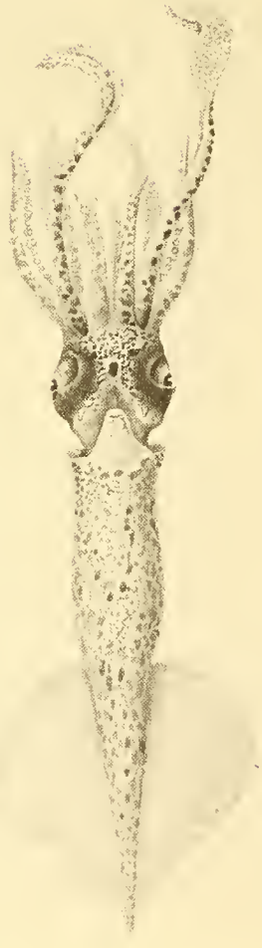

Plate XXXI

Figures 1, 2, 3, 5, 7, 8. *Brachioteuthis picta* n. sp.
Figures 4, 6. Juvenile forms of *Brachioteuthis* (*Tracheloteuthis*). Gladius and arm apparatus

Figure 1. *Brachioteuthis picta* Ch. Gladius, ventral × 5
Figure 2. *Br. picta.* Left club, outer surface. × 10
Figure 3. Same, inner surface.
Figure 4. Club of juvenile form from Station 236 (cf. Plate XXX, Figures 2, 3)
Figure 5. Large sucker of club of *Br. picta.*
Figure 6. Club of juvenile form from Station 66 (cf. Plate XXX, Figure 1). Appr. × 20
Figure 7. Row of suckers in middle of 3rd arm of *Brachioteuthis picta*, ventral. Appr. × 18
Figure 8. Same, dorsal. Appr. × 18

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Plate XXXII

Brachioteuthis (*Tracheloteuthis*) *picta* n.sp. Head, intestinal tract, and vascular system

Figure 1. Mantle complex. Funnel slightly displaced. × 4
Figure 2. Head with neck folds, olfactory tubercle, and funnel, left side. × 10
Figure 3. Visceral complex, right side. × 11
Figure 4. Intestinal tract, left side. × 11
Figure 5. Neck cartilage. × 8
Figure 6. Vascular system, dorsal. × 11

ABBREVIATIONS

a. branch.—branchial artery
a. ceph.—cephalic aorta
a. pall.—pallial artery
a. post.—posterior artery
app. an.—anal appendages
app. c.—appendage of branchial heart
atr.—ink sac
c.—heart
c. branch.—branchial heart
hep.—liver
int.—mid-intestine
lig. g. g.—gastro-genital ligament
mu. depr. inf.—funnel depressor
n. visc.—visceral nerve
oes.—esophagus
pancr.—pancreas
pancr.^{1}—anterior lobe of pancreas
rect.—rectum
sacc. v.—venous sac
sacc. v.^{1}—anterior venous sac
sacc. v.^{2}—posterior venous sac
sin. st.—sinus of stomach
st.—stomach
st. coec.—caecum
st. coec.^{1}—hood of caecum
test.—testis
v. abd.—abdominal vein
v. branch.—branchial vein
v. c.—vena cava
v. hep.—hepatic vein
v. pall.—pallial vein

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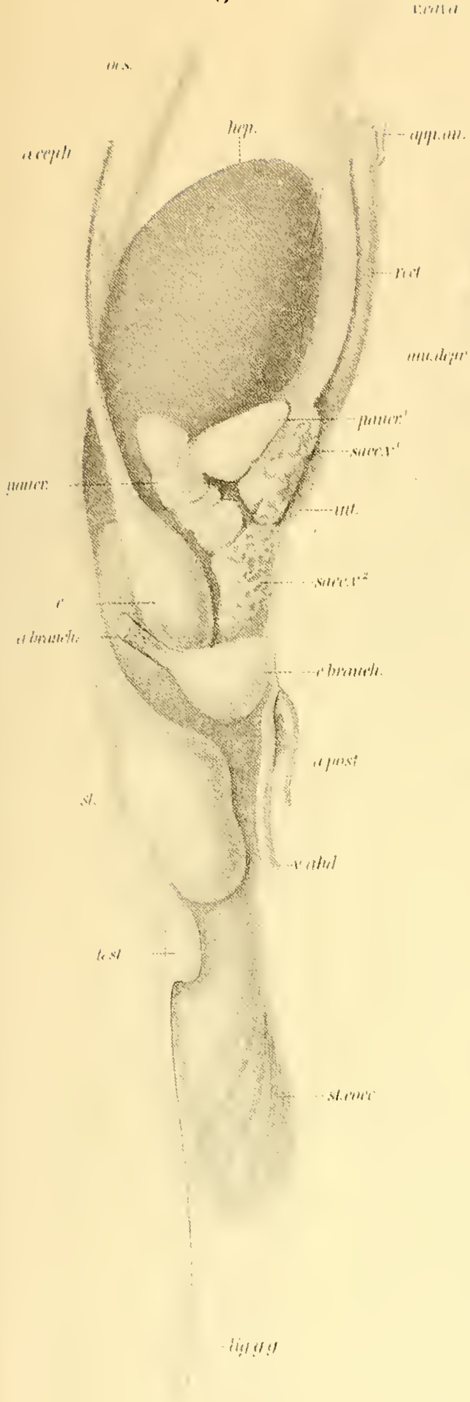
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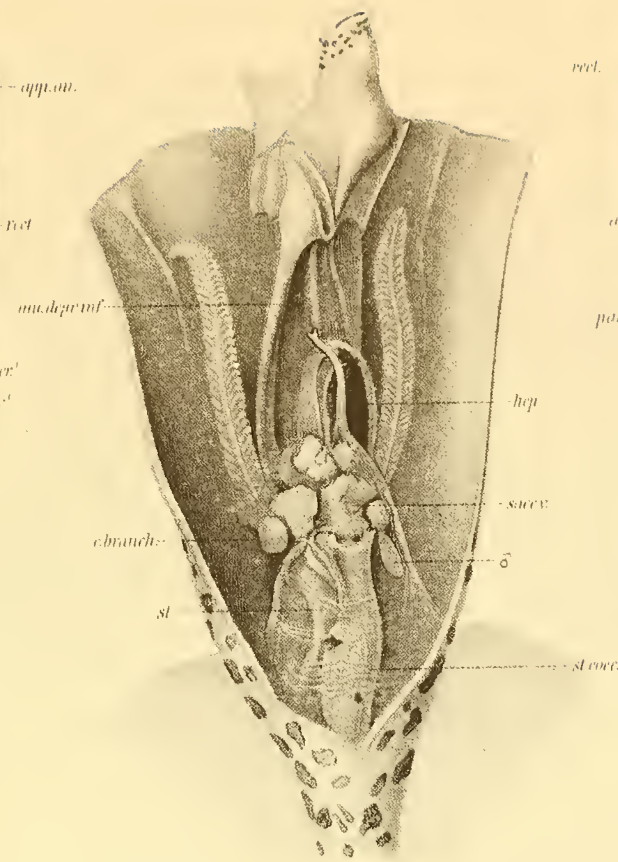
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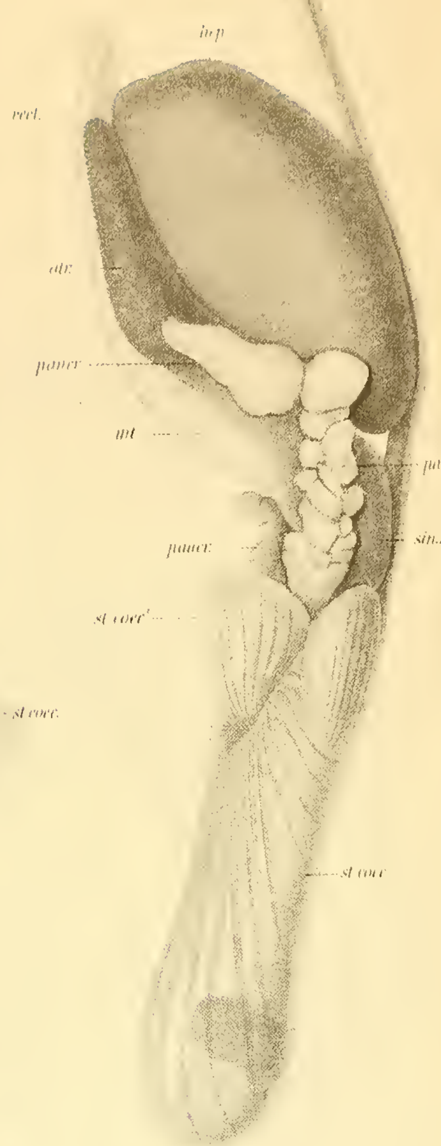
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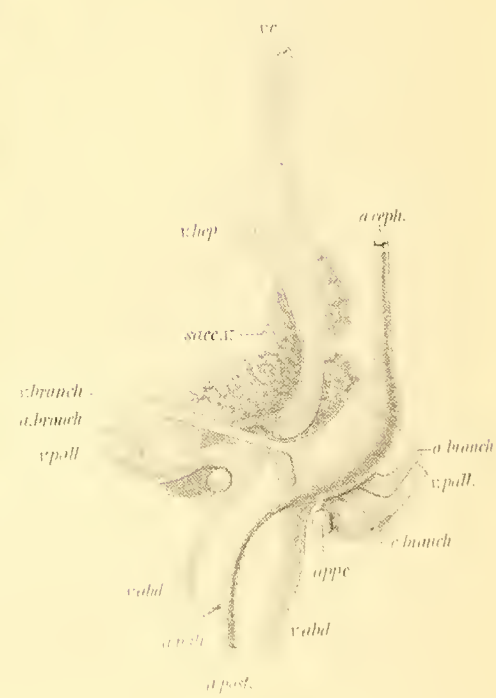
v.hep
a.ceph.
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a.branch
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Plate XXXIII

Figures 1–2. *Mastigoteuthis glaukopis* n.sp.

Figure 1. *M. glaukopis*, left side. Station 261, Indian South Equatorial Current near East Africa. × 2

Figure 2. Same, ventral.

Figures 3, 4. *M. flammea* n.sp.

Figure 3. *M. flammea*, dorsal. Station 64, near São Tomé Island in the South Atlantic. × 2

Figure 4. Same, ventral. × 2

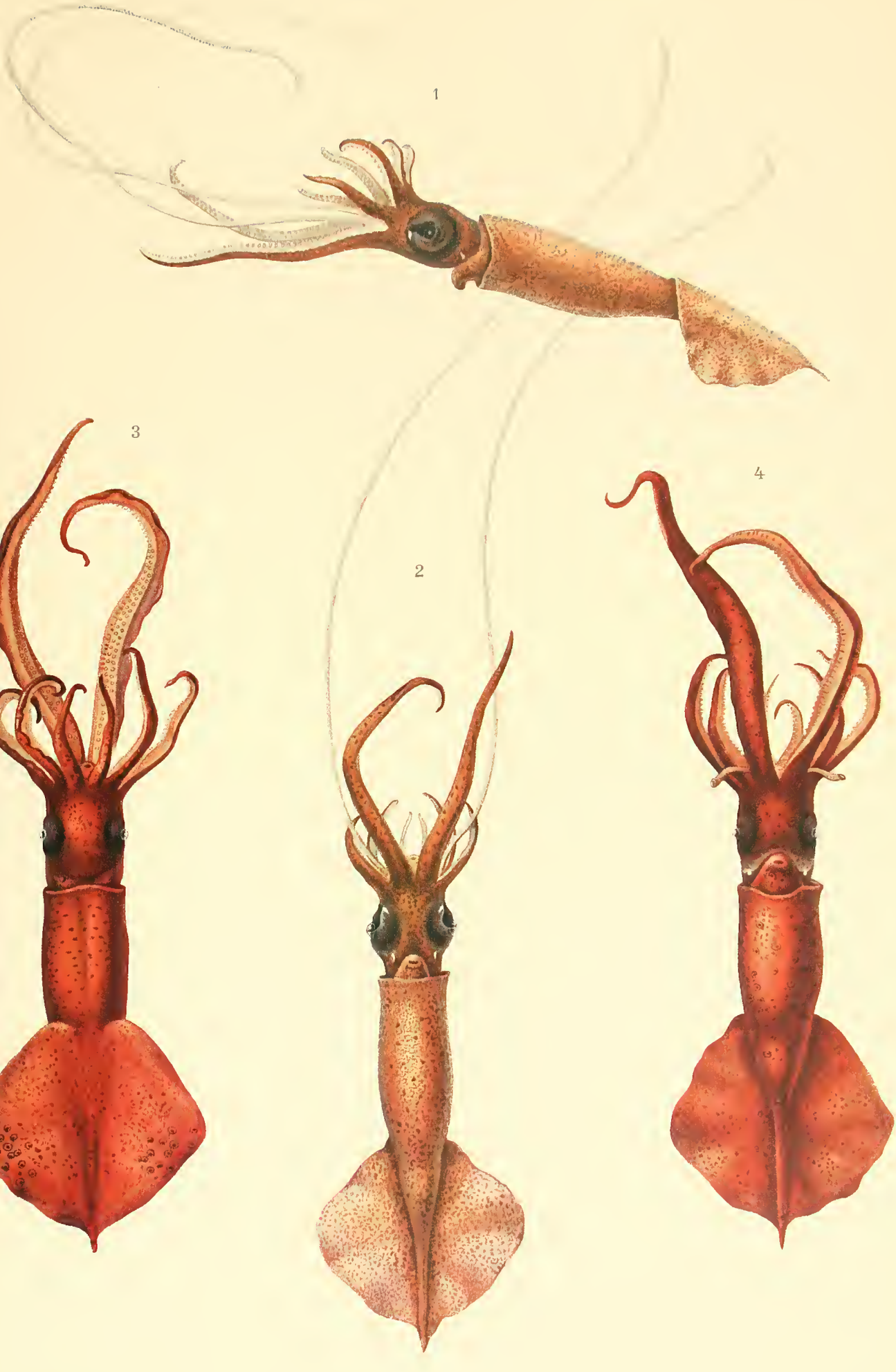
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Plate XXXIV

Mastigoteuthis cordiformis n.sp.

Figure 1. *M. cordiformis*, dorsal. Station 194, Indian Countercurrent near Nias. Natural size

Figure 2. Same, ventral.

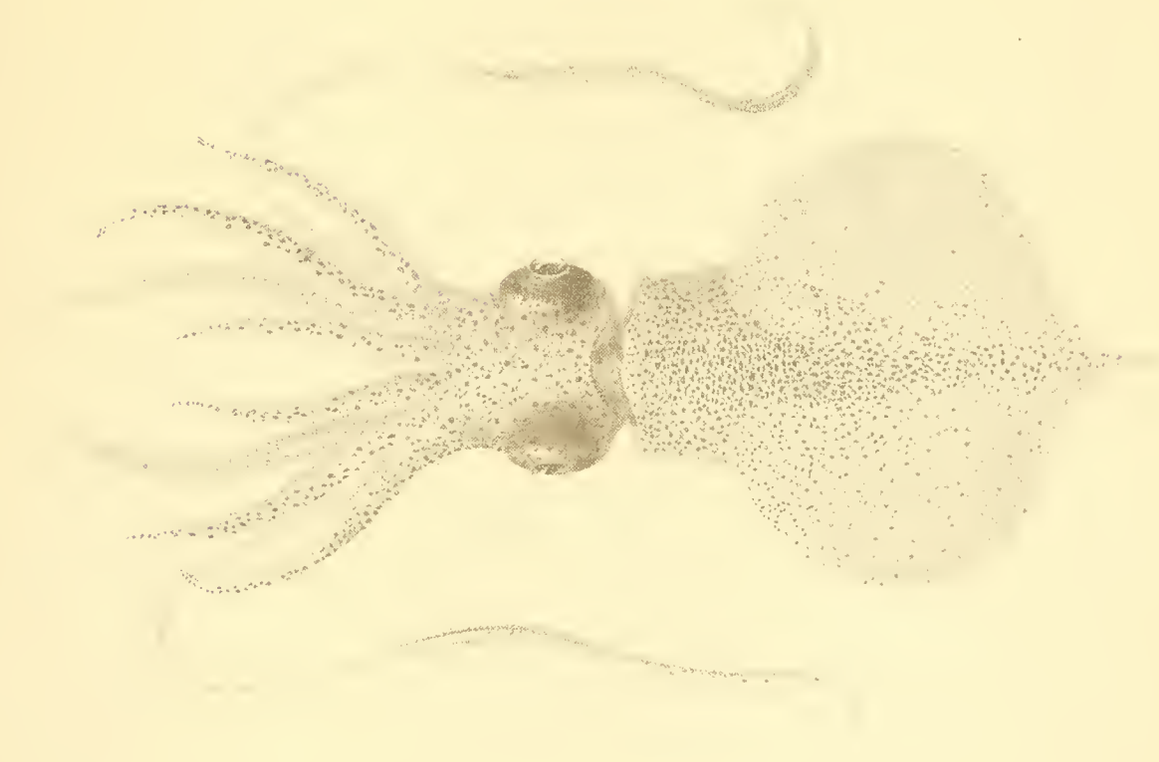

Plate XXXV

Mastigoteuthis VERRILL. Gladius, cartilage, and arm apparatus

Figure 1. *Mastigoteuthis cordiformis* n.sp. Right funnel cartilage. Station 194
Figure 2. *M. glaukopis* n.sp. Right funnel cartilage. Station 261
Figure 3. *M. flammea.* Right funnel cartilage. Station 53
Figure 4. *M. flammea.* Right funnel cartilage. Station 64
Figure 5. *M. cordiformis.* Gladius, ventral. × 2
Figure 6. Same, right side. × 2
Figure 7. Neck cartilage of *M. flammea.* Station 64
Figure 8. Bases of arms, buccal funnel, and tentacles of *M. cordiformis*, seen from above. × 2
Figure 9. Buccal funnel and its attachment, *M. flammea.* Station 64
Figure 10. Proximal part of club of *M. cordiformis.*
Figure 11. Tentacle sucker of *M. cordiformis*, lateral.
Figure 12. Tentacle sucker of *M. cordiformis*, seen from above.
Figure 13. Arm sucker of *M. cordiformis*, lateral.
Figure 14. Arm sucker of *M. cordiformis*, seen from the opening.
Figure 15. Tentacle of *M. glaukopis.* Station 261. Appr. × 2.5
Figure 16. Part of club of *M. glaukopis*, outer side. Appr. × 20

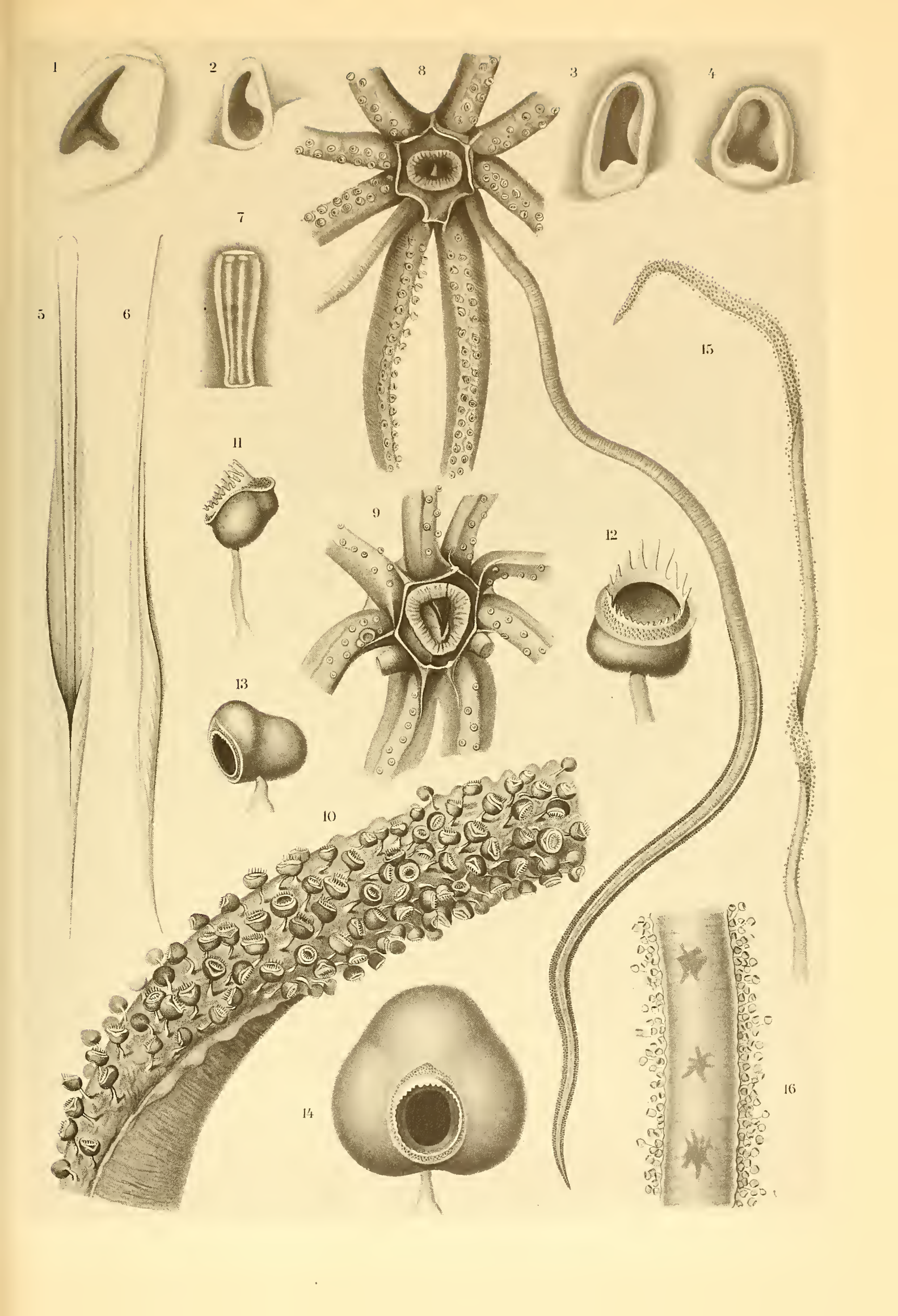
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Plate XXXVI

Mastigoteuthis. Anatomy

Figure 1. *Mastigoteuthis flammea*. Mantle complex, ventral. Station 64. Left gill cut at base of branchial heart and folded aside. Abdominal wall removed on left side

Figure 2. *Mastigoteuthis flammea*. Mantle complex of specimen from Station 53, ventral

Figure 3. *Mastigoteuthis cordiformis*. Mantle complex, ventral

Figure 4. *Mastigoteuthis cordiformis*. Stomach and caecum with gastric ganglion and veins. Ventral

Figure 5. *Mastigoteuthis cordiformis*. Neck cartilage. × 3.5

ABBREVIATIONS

a. branch.—branchial artery
a. post.—posterior artery
app. c.—appendage of branchial heart
c.—heart
c. branch.—branchial heart
g. gastr.—gastric ganglion
g. stell.—stellate ganglion
hep.—liver
int.—mid-intestine
lig. g. g.—gastro-genital ligament
luc.—luminous organ
mu. coll.—collaris
mu. depr. inf.—funnel depressor
n. pall.—pallial nerve
nid.—nidamental gland
oes.—esophagus
ov.—ovary
pancr.—pancreas
rad.—spiral folds
sacc.—abdominal wall
sacc. v.—venous sac
st.—stomach
st.[1]—tip of stomach
st. coec.—caecum
susp.—ligament of gills
tub. olf.—olfactory tubercle
ur.—papilla of renal sac
v. abd.—abdominal vein
v. branch.—branchial vein
v. c.—vena cava
v. g.—gastric vein
v. pall.—pallial vein

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lac.
atr.
mu depr inf.
ur
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sacc.
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v.branch.
a.branch
v.pall
hep.
stom.coec.
lig g.g.
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v pall
a branch
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v abd
a post
hg.g.g
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sacc.v
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ur
nid
nid
v branch
a branch.
c.branch.
a post
rad.
st
rad.
ovs
g.gastr
st
st.coec.

Plate XXXVII

Mastigoteuthis. Luminous organs

Figure 1. *Mastigoteuthis glaukopis* n.sp., Station 261. Longitudinal section of organ of left eye. Formol, alcohol-hemalum. × 130

Figure 2. *M.flammea* n.sp., Station 64. Section through mantle organ. Formol, alcohol-hemalum

Figure 3. *M.flammea*, Station 64. Section through mantle organ.

Figure 4. Mantle organs of *M.flammea*, surface view. Under magnifying glass

Figure 5. *M.cordiformis* n.sp. Section through conical tubercle (luminous organ?) of skin

ABBREVIATIONS

chr.—chromatophores
ep.—epithelium
gel.—gelatinous connective tissue
mu.—muscle fibers
phot.—luminous body
v.—vessel
x.—central cord of cells

1
nm.
v.
phot.
gel.
2
chr.
x.
phot.
3
chr.
x
x
phot.
4
5
ep.
chr.

Plate XXXVIII

Chiroteuthis (*Chirotauma*) *imperator* n. sp.

Specimen from Station 194, South Channel of Nias. Natural size

Figure 1. Right side.
Figure 2. Dorsal.

Plate XXXIX

Chiroteuthis, *Doratopsis*

Figures 1–10. *Ch. imperator*. Station 194, Indian Countercurrent, near Nias

Figure 1. Neck cartilage and opposite cartilage. Natural size
Figure 2. Buccal funnel with attachments and arm bases, seen from above.
Figure 3. Buccal funnel, ventral surface, lateral.
Figure 4. Arm suckers, lateral.
Figure 5. Arm suckers, seen from the opening.
Figure 6. Tentacle suckers, seen from the opening.
Figure 7. Tentacle suckers, lateral.
Figure 8. Left funnel cartilage. × 5
Figure 9. Right funnel cartilage. × 5
Figure 10. Opposite cartilage of mantle. × 5

Figures 11–15. *Doratopsis*

Figure 11. Tentacle of *D. exophthalmica*, Station 169.
Figure 12. Tentacle club of *D. lippula*, Station 74.
Figure 13. Tentacle club of *D. exophthalmica*, Station 26.
Figure 14. Base of large ventral arm of *D. exophthalmica*, Station 169.
Figure 15. Base of large ventral arm of *D. sagitta*, Station 39.

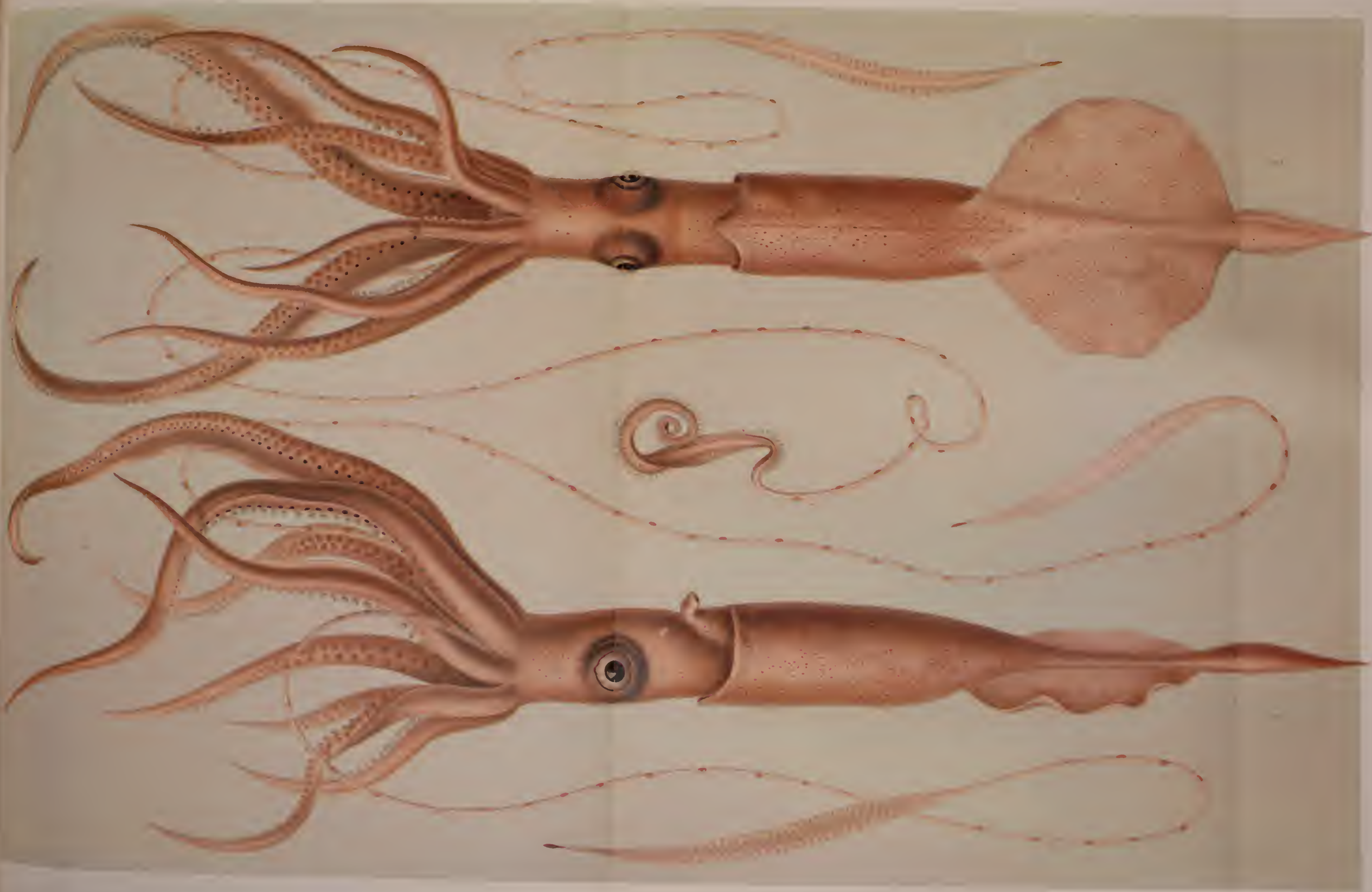

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Plate XL

Chiroteuthis

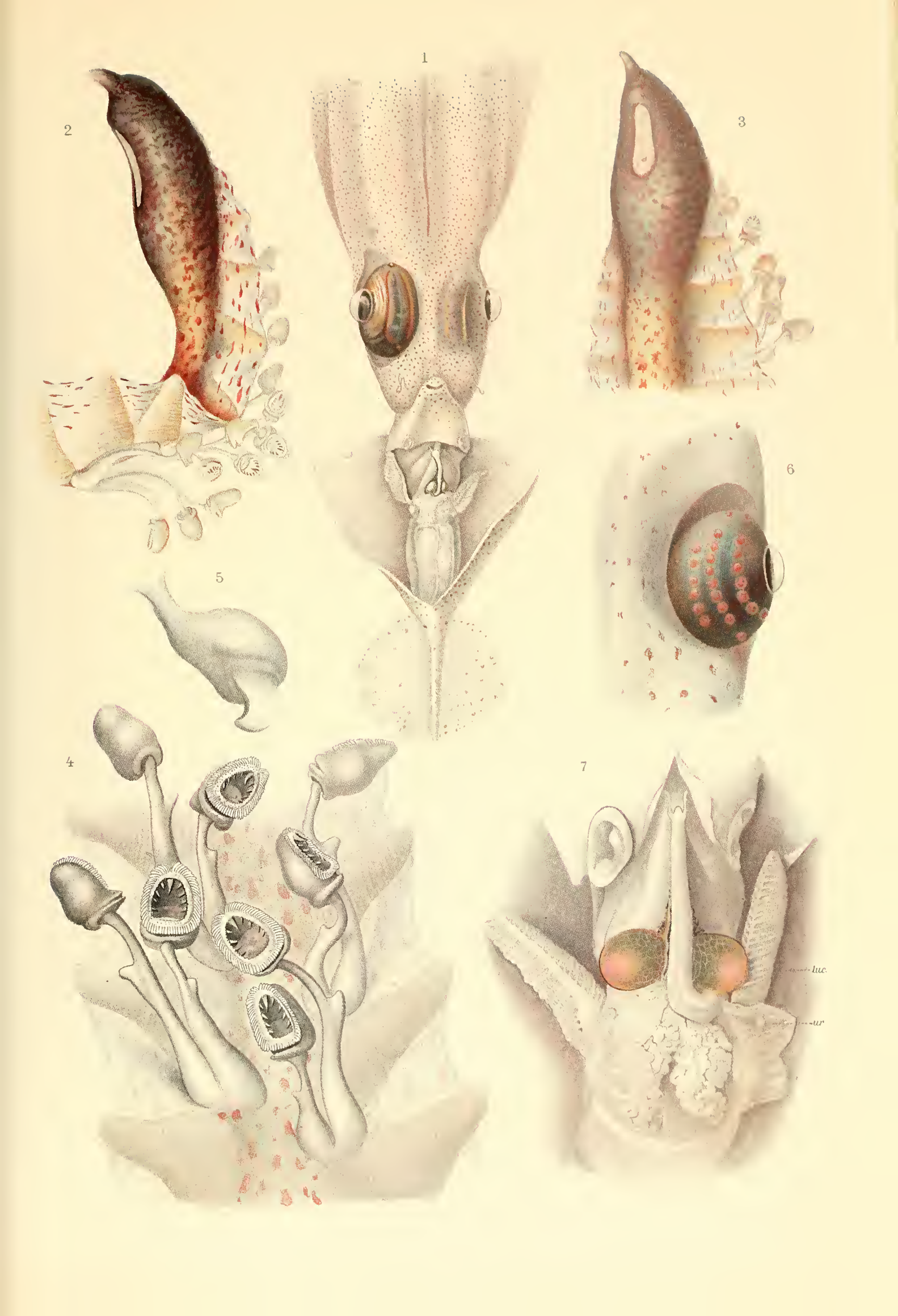
Figure 1. *Ch. veranyi* FÉRUSSAC. Adult male, natural size, ventral. Mantle was opened and the right eye exposed to show the luminous stripes

Figures 2–7. *Ch. imperator*

Figure 2. End of tentacle club with glandular knob, lateral. Station 194. Appr. × 20
Figure 3. Glandular knob on club tip, external surface.
Figure 4. Part from middle of tentacle club. Specimen from Sagami Bay
Figure 5. Olfactory tubercle, diagonally lateral. Station 194
Figure 6. Left eye of *Ch. picteti*, after JOUBIN's description of original specimen
Figure 7. *Ch. imperator*. Mantle complex of younger male with both ventral luminous organs. Renal sac opened. Sagami Bay

ABBREVIATIONS

luc.—ventral luminous organs
ur.—papilla of renal sac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7
luc.
ur

Plate XLI

Chiroteuthis imperator. Nervous system, gladius, viscera

Figure 1. Nervous system of medium-sized specimen, dorsal. Visceral nerve and its branches was slightly displaced to the right
Figure 2. Inferior buccal ganglion with adjacent anterior salivary glands and branches of buccal artery.
Figure 3. Stellate ganglia and commissure of medium-sized specimen.
Figure 4. Right orbit after removal of eye, with parts of central nervous system shining through. × 5.2
Figure 5. Central nervous system and thicker nerves of large specimen from Station 194. Left side. Cartilage of static organ cut open. Larger arteries and veins also indicated. Of the intestinal tract, course of esophagus and position of posterior salivary gland is indicated. × 4.7
Figure 6. Gastric ganglion with nerves.
Figure 7. Heart, branchial hearts with efferent vessels and left oviduct of medium-sized specimen. Dorsal diagonal view. Oviduct not presented in right half of figure. × 4.2
Figure 8. Opening of right oviduct near branchial ganglion, ventral surface.
Figure 9. Vena cava and appendage below point of entrance into cranium, with funnel nerves and adjacent muscle part. Lateral
Figure 10. Gladius of medium-sized specimen, dorsal surface. Natural size
Figure 10a, b, c. Slightly enlarged cross sections of gladius at level indicated by dotted lines.
Figure 11. Same gladius, right side.
Figure 12. Initial part of cone, ventral, under the magnifying glass.
Figure 13. Posterior tip of gladius, lateral, showing also end of gelatinous tube and the delicate septa. × 14
Figure 14. Initial part of cone of large specimen from Station 194, with projecting gelatinous pad and end of gastro-genital ligament. Viewed diagonally from the right
Figure 15. Section from posterior half of body, dissectioned out to show initial part of cone and adjacent organs, ventral
Figure 16. Same preparation, left side.
Figure 17. Male gonoducts of younger specimen, dorsal. × 6
Figure 18. Same, ventral. × 6
Figure 19. Testis of young male, ventral surface.
Figure 20. Same, lateral, with posterior end of stomach and gastro-genital ligament.

ABBREVIATIONS

a. brach.—brachial artery
a. branch.—branchial artery
a. ceph.—cephalic aorta
a. ophth.—ophthalmic artery
a. pancr.—pancreatic artery
a. phar.—pharyngeal artery
a. pinn.—fin artery
a. post.—posterior artery
a. saliv.—salivary artery
add. inf.—funnel adductor
alb.—white body
amp.—opening of vas deferens
app. c.—appendage of branchial heart
app. prost.—appendage of prostate
b. sperm.—spermatophore sac (Needham's sac)
c.—heart
c. b. s. i.—commissure of buccal ganglia
c. brach. b.—brachio-buccal commissure
c. branch.—branchial heart
c. cer. b.—cerebro-buccal commissure
c. cer. br.—cerebro-brachial commissure
c. cer. ped.—cerebro-pedal commissure
c. cil.—ciliated canal
c. visc. a.—anterior visceral commissure
c. visc. p.—posterior visceral commissure
coec. v. c.—appendage of vena cava
con.—cone of gladius
d. saliv.—duct of posterior salivary gland
div. oes.—diverticulum of esophagus
g. brach.—brachial ganglion
g. branch.—branchial ganglion
g. bucc. inf.—inferior buccal ganglion
g. bucc. sup.—superior buccal ganglion
g. cer.—cerebral ganglion
g. gastr.—gastric ganglion
g. ped.—pedal ganglion
g. spl.—splanchnic ganglion
g. stell.—stellate ganglion
g. visc.—visceral ganglion
glad.—gladius
gl. od.—oviduct gland
lig. g. g.—gastro-genital ligament
m. cr.—cranial ridge
mu.—muscle
mu. flab.—fan-shaped muscle
mu. pall.—mantle musculature
n. a. o. i.—inferior antorbital nerve
n. a. o. s.—superior antorbital nerve
n. atr.—nerve to ink sac
n. brach.—brachial nerve
n. brach. 1, 2, 3, 4—branches of brachial nerve to 1st, 2nd, 3rd, 4th arms
n. branch.—branchial nerve
n. c. branch.—nerve of branchial heart
n. inf.—funnel nerve
n. inf. orb.—orbital branch of funnel nerve
n. i. phar.—nerves of inferior buccal ganglion
n. o. m., *n. o. mot.*—oculomotor nerve
n. olf.—olfactory nerve
n. ophth. i.—inferior ophthalmic nerve
n. ophth. s.—superior ophthalmic nerve
n. opt.—optic nerve
n. p. orb.—postorbital nerve
n. pall.—pallial nerve
n. s. phar.—nerves of supraesophageal ganglion
n. stat.—static nerve
n. symp.—sympathetic nerve
n. tent.—nerve of tentacle
n. visc.—visceral nerve
o. stat.—static organ
oes.—esophagus
od.—oviduct
pen.—end of spermatophore sac
prost.—prostate
r.—nerve branch
r. d. hep.—nerve branch to hepatic duct
r. pancr.—nerve branch to pancreas
r. stom.—nerve branch to stomach
r. stom. coec.—nerve branch to caecum
sacc. glad.—shell gland
sacc. v.—venous sac
saliv. a.—anterior salivary gland
saliv. p.—posterior salivary gland
sept.—septa of cone
stom.—stomach
test.—testis
v.—vein
v. abd.—abdominal vein
v. branch.—branchial vein
v. c.—vena cava
v. cr.—cranial vein
v. def.—vas deferens
v. eff.—vas efferens
v. lien.—splenic vein
v. saliv.—salivary vein
ves. sem. 1, *ves. sem. 2*, *ves. sem. 3*—1st, 2nd and 3rd part of seminal vesicle
x.—gelatinous swelling of cone

Plate XLII

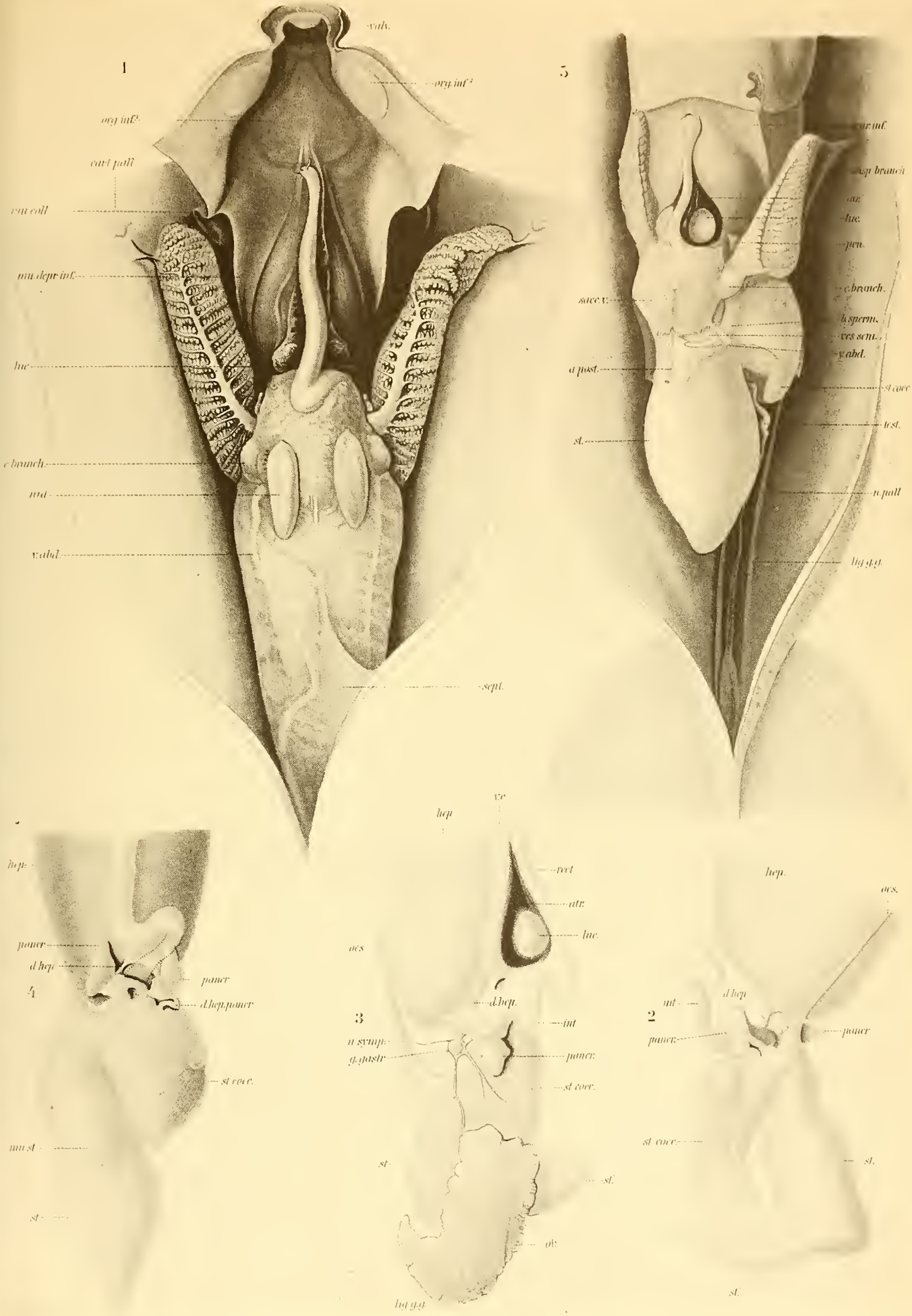
Chiroteuthis. Mantle complex and intestinal tract

Figures 1–4. *Ch. imperator*

Figure 1. Mantle complex of specimen from Station 194, ventral. Funnel opened
Figure 2. Intestinal tract of younger female, left side.
Figure 3. Viscera of same specimen, right side, with ovary situated on them.
Figure 4. Intestinal tract of young male, ventral. Mid-intestine cut at exit from stomach; dots indicate its position. × 3
Figure 5. *Chiroteuthis veranyi* Férussac. Mantle complex of adult male from Messina. Ventral surface, viewed slightly diagonally from the left

ABBREVIATIONS

a. post.—posterior artery
atr.—ink sac
b. sperm.—spermatophore sac
c. branch.—branchial heart
cart. pall.—mantle cartilage
d. hep.—hepatic duct
d. hep. pancr.—hepato-pancreatic duct
g. gastr.—gastric ganglion
hep.—liver
int.—mid-intestine
lig. g. g.—gastro-genital ligament
luc.—ventral luminous organ
mu. coll.—collaris
mu. depr. inf.—funnel depressor
mu. st.—muscular ridge of stomach
n. pall.—mantle nerve
n. symp.—sympathetic nerve
nid.—nidamental gland
oes.—esophagus
org. inf.^{1}—median funnel organ
org. inf.^{2}—lateral funnel organ
ov.—ovary
pancr.—pancreas
pen.—end of spermatophore sac
rect.—rectum
sacc. v.—venous sac
sept.—mantle septum
st.—stomach
st.^{1}—appendage of stomach
st. coec.—caecum
susp. branch.—branchial ligament
test.—testis
v. abd.—abdominal vein
v. c.—vena cava
valv.—funnel valve
ves. sem.—seminal vesicle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valv.
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org. inf.²
cart. pall.
mu. coll.
mu. depr. inf.
luc.
c. branch.
nid.
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ar. inf.
isp. branch
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pen.
c. branch.
sacc. v.
h. sperm.
ves. sem.
v. abd.
a. post.
st. coec.
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Plate XLIII

Chiroteuthis imperator

Figure 1. Mantle complex of specimen from Station 194, ventral.

Figure 2. Specimen from Sagami Bay. Head viewed from the ventral side, to show the luminous organs of the eye and the nerves and vessels that extend from base of cranium

Figure 3. Dorsal view of head, showing cranial capsule and organs situated outside it. Sagamy Bay

Figure 4. Same specimen as in Figure 3, with cranial capsule and anterior nerves removed.

ABBREVIATIONS

a. ceph.—cephalic aorta
a. ophth.—ophthalmic artery
atr.—ink sac
b. cran.—base of cranium
brach. IV—4th arm
c. alb.—white body
c. branch.—branchial heart
cart. inf.—funnel cartilage
cart. nuch.—neck cartilage
cart. pall.—mantle cartilage
comm. b. s. i.—commissure between superior and inferior buccal ganglion
comm. cer. b.—cerebro-buccal commissure
con.—cone of gladius
cran.—cranium
g. brach.—brachial ganglion
g. bucc. inf.—inferior buccal ganglion
g. bucc. sup.—superior buccal ganglion
g. cer.—cerebral ganglion
g. opt.—optic ganglion
gel.—gelatinous tissue
gel. con.—gelatinous swelling of cone
gel. pall.—gelatinous tissue of mantle
inf.—funnel
luc.—luminous organ
luc.^{1}—outer row of eye organ
luc.^{2}—middle row of eye organs
luc.^{3}—inner row of eye organs
m. bucc.—buccal membrane
mu. depr. inf.—funnel depressor
mu. palp.—muscular mass of lid
n. brach. 1, *n. brach. 2*, *n. brach. 3*, *n. brach. 4*—nerves to 1st, 2nd, 3rd, 4th arms, respectively
n. inf.—funnel nerve
n. ophth. sup.—superior ophthalmic nerve
n. pall.—pallial nerve
n. pall. d.—right pallial nerve
n. s. phar.—nerves of supraesophageal ganglion
n. symp.—sympathetic nerve
n. tent.—nerve of tentacle
nid.—nidamental gland
oes.—esophagus
ov.—ovary
phar.—pharynx
rect.—rectum
sacc.—abdominal wall
sacc.^{1}—right abdominal wall
saliv. ant.—anterior salivary gland
saliv. post.—posterior salivary gland
s. v. c.—appendix of vena cava
s. ven.—venous sacs
st.—stomach
v. abd.—abdominal vein
v. c.—vena cava

Plate XLIV

Chiroteuthis. Luminous organs and glandular knobs

Figure 1. *Chiroteuthis veranyi* FÉRUSS., Messina. Luminous organ on ventral arm, longitudinal section. Formol, alcohol, hemalum. × 110

Figure 2. *Ch. veranyi.* Longitudinal section of ventral organ

Figure 3. *Ch. imperator.* Part of luminous body of ventral organ; homog. imm. 1/12 (reduced). Formol, alcohol, hemalum

Figure 4. *Ch. veranyi.* Confluence of several septa in gelatinous body of ventral organ; homog. imm. 1/12 (reduced)

Figure 5. *Ch. veranyi.* Thick nerve extending along anterior dorsal surface of ventral organ; homog. imm. 1/12 (reduced)

Figure 6. *Ch. imperator.* Longitudinal section through eye organ. Formol, alcohol, hemalum

Figure 7. *Ch. imperator.* Part of luminous body of eye organ. Formol-alcohol, hemalum; homog. imm. 1/12

Figure 8. *Ch. imperator.* Vessel entering eye organ; homog. imm. 1/12 (reduced)

Figure 9. *Ch. imperator.* Fibers of lens of eye organ:
a) longitudinally, b) cross section.
Homog. imm. 1/12. Formol, alcohol, hemalum

Figure 10. *Ch. imperator.* Horizontal section of glandular knob at end of tentacle club. Formol, alcohol, acid carmine

Figure 11. *Ch. imperator.* Longitudinal section of glandular knob at end of club. Formol, alcohol, acid carmine

Figure 12. *Ch. imperator.* Cross section of tentacle stalk of younger specimen, with glandular knob situated on top

Figure 13. *Ch. imperator.* Basal part of glandular knob of tentacle club. Horizontal section. Formol, alcohol, hemalum; homog. imm. 1/12 (reduced)

Figure 14. *Ch. imperator.* Basal part of gland lamella. Longitudinal section of luminous organ of tentacle club; homog. imm. 1/12 (reduced)

Figure 15. *Ch. imperator.* Basal part of organ of tentacle club. Longitudinal section; homog. imm. 1/12 (reduced)

Figure 16. *Ch. imperator.* Cross section of distal region of gland lamellae. Organ of tentacle club

ABBREVIATIONS

art.—artery
atr.—ink sac
bg.—connective tissue
cap.—capillaries
chr.—chromatophores
chr. pg.—chromatophores of arm organ
cps.—sheath of arm organ
cut.—skin
ep.—epithelium
fibr.—fibrous cords of reflector
gel.—gelatinous tissue
gel. cut.—gelatinous tissue of skin
hom.—gelatinous mass of gland lamellae
l.—lens
l.[1]—lens fibers, cut
lam.—gland lamellae
mu.—musculature
mu. circ.—circular muscle fibers
mu. tent.—musculature of tentacle
n.—nerve
n. tent.—nerve of tentacle
nu.—nuclei
nu. cap.—nuclei of capillaries
nu. phot.—nuclei of luminous body
phot.—luminous body
plica—skin fold
refl.—reflector
ret.—knots of meshes of connective tissue
sang.—blood corpuscles
secr.—secretion
v.—vessel

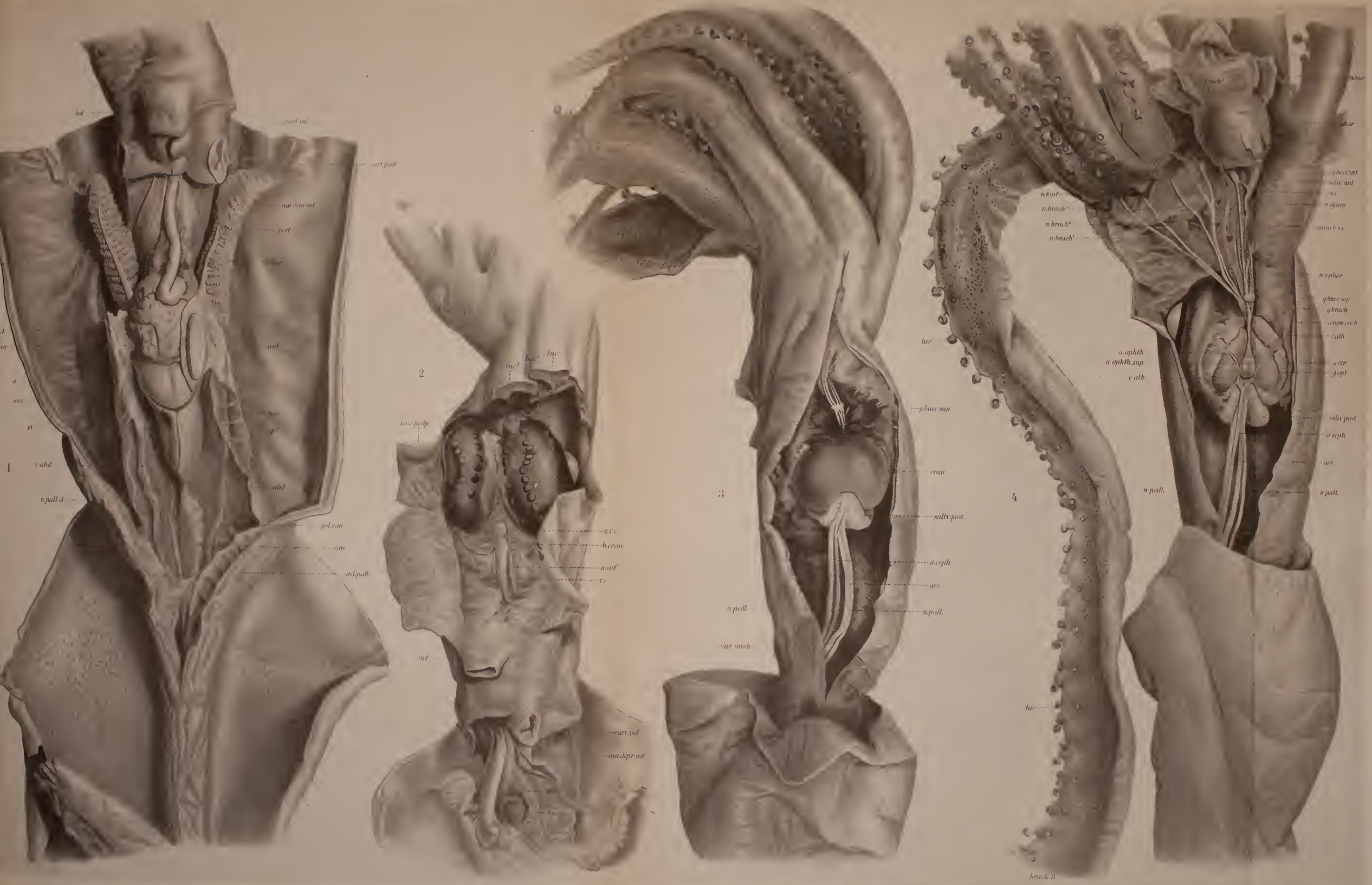
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Plate XLV

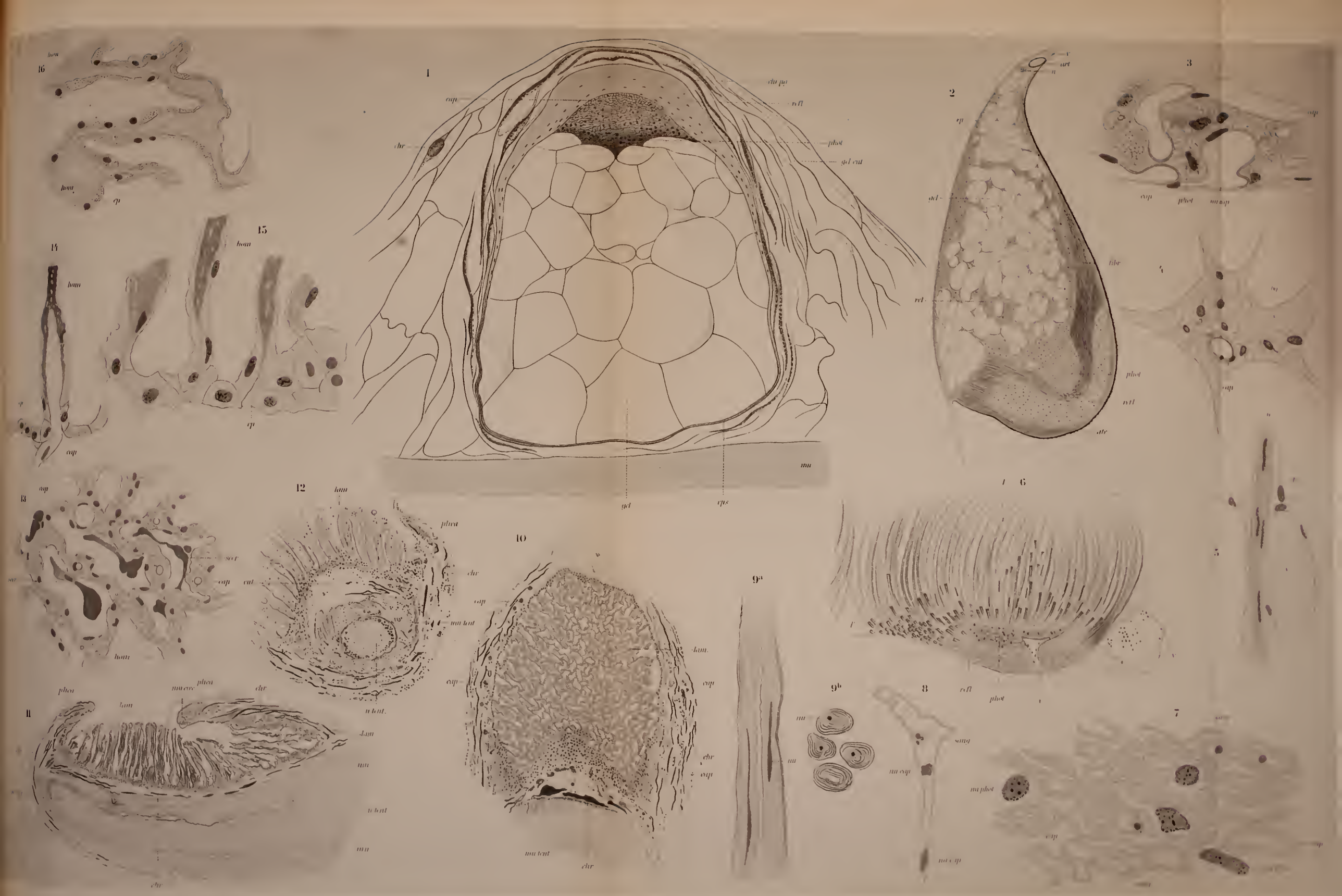
Doratopsis DE ROCHEBRUNE

Figures 1–5. *Doratopsis sagitta* n.sp.

Figure 1. *Doratopsis sagitta*, dorsal. Station 172, South Indian doldrum belt. × 3
Figure 2. Same, ventral surface. × 3
Figure 3. *D. sagitta*, dorsal surface. Station 39, Guinea Current. × 3
Figure 4. Same, ventral surface.
Figure 5. *D. sagitta*. Head of specimen from Station 39, lateral. × 12.

Figures 6–7. *Doratopsis lippula* n.sp.

Figure 6. *D. lippula*, dorsal surface. South Equatorial Current
Figure 7. Same, ventral surface.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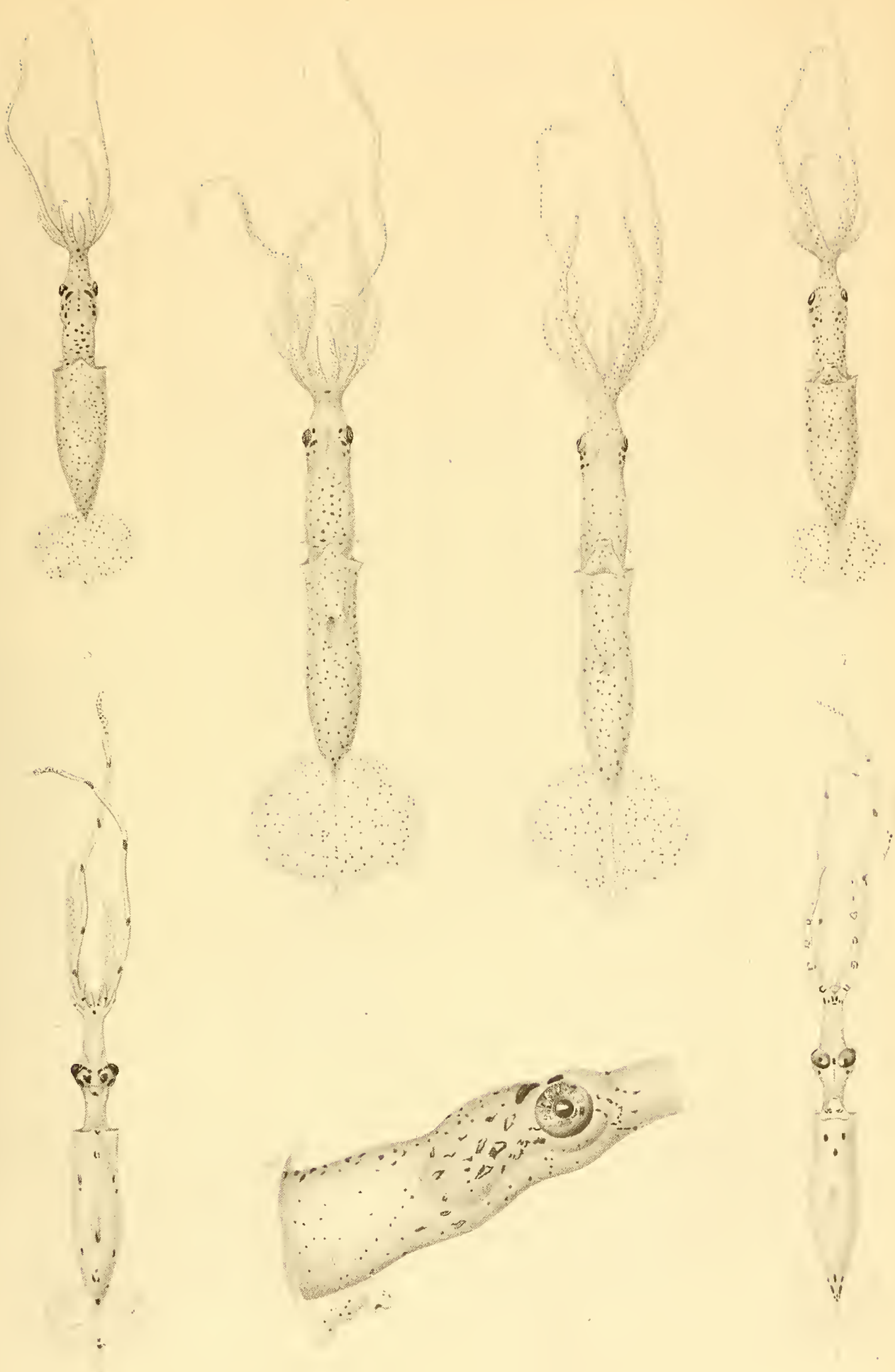

Plate XLVI

Doratopsis DE ROCHEBRUNE

Figures 1–5. *Doratopsis exophthalmica* n.sp.

Figure 1. *D. exophthalmica.* Station 26, Canaries Current. × 3
Figure 2. Same, ventral. × 3
Figure 3. *D. exophthalmica* from Station 169, South Indian doldrum belt. Left side. × 3
Figure 4. Same, dorsal surface. × 3
Figure 5. Head of specimen from Station 169, lateral. × 15

Figures 6–7. *Doratopsis lippula* n.sp.

Figure 6. Anterior part of body of *D. lippula.* Station 74, Benguela Current. × 3
Figure 7. Head of specimen from Station 74, lateral.
Figure 8. Youngest larva of *Doratopsis.* Station 228, Indian Countercurrent. × 3
Figure 9. Same larva, dorsal surface. × 3
Figure 10. Same larva, ventral surface. × 8

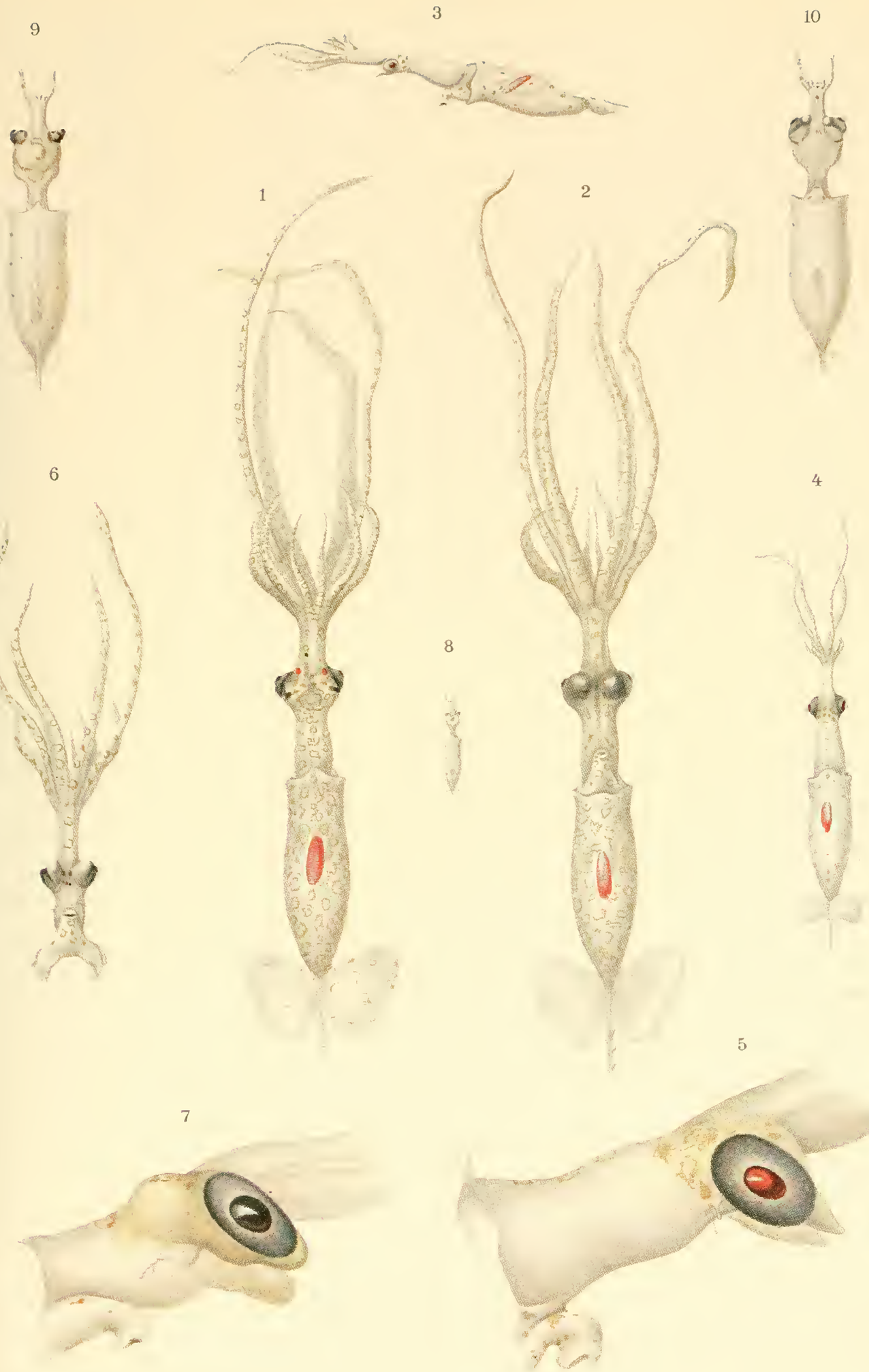
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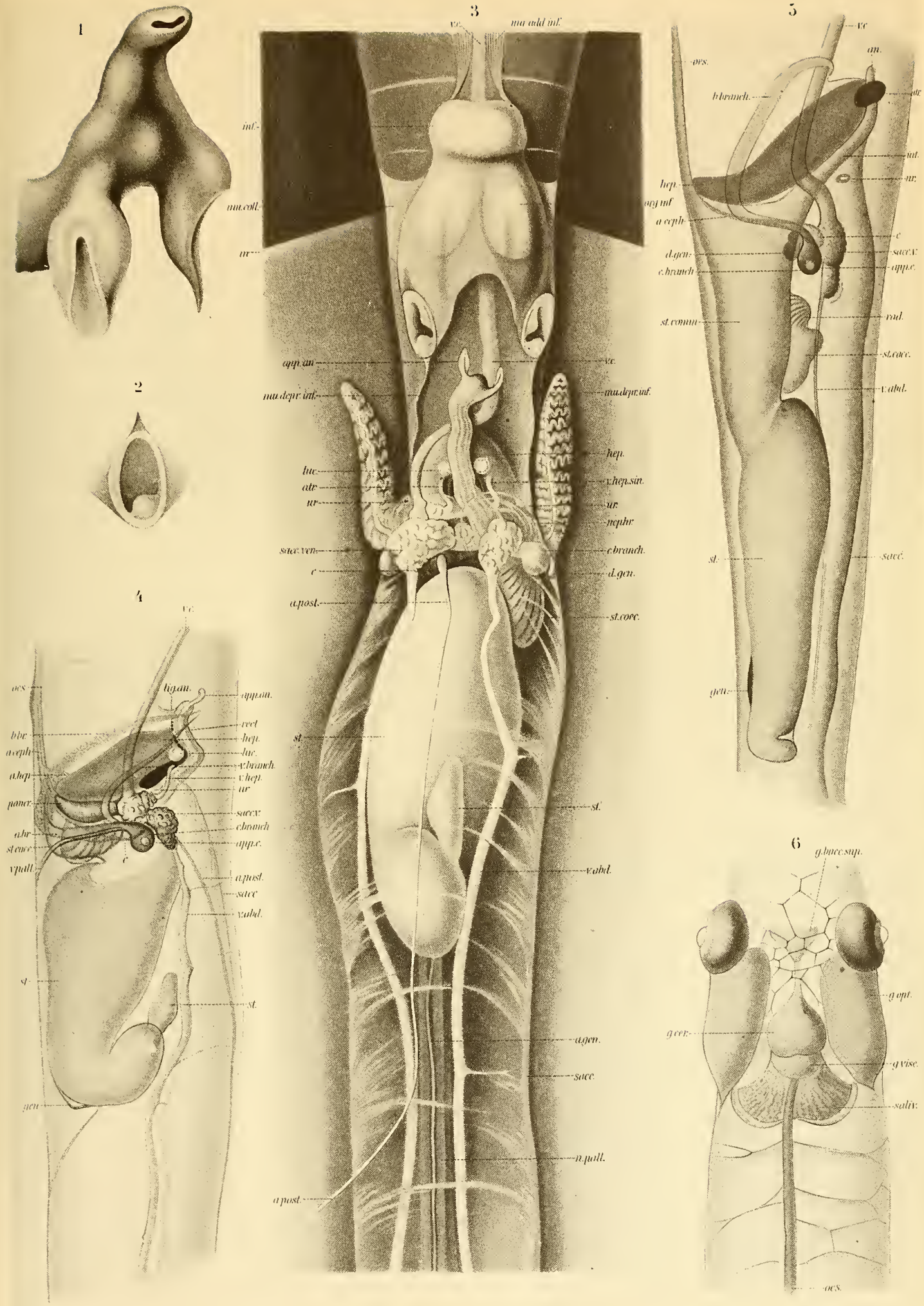
Plate XLVII

Anatomy of *Doratopsis*

Figure 1. Funnel and funnel cartilage of *D. sagitta*, Station 172.
Figure 2. Left funnel cartilage and antitragus of *D. exophthalmica*, Station 26.
Figure 3. Mantle complex of *D. vermicularis* RÜPPELL from Messina, ventral.
Figure 4. Visceral complex of same larva, right side. × 12. (Only basal part of gill—i.e. the branchial gland—shown)
Figure 5. Visceral complex of *D. sagitta*, right side. Station 172. (Only the branchial gland shows the position of the gill)
Figure 6. *D. sagitta*. Head of specimen from Station 172, dorsal. × 12

ABBREVIATIONS

a. br.—branchial artery
a. ceph.—cephalic aorta
a. gen.—artery of gastro-genital ligament
a. hep.—hepatic artery
a. post.—posterior artery
an.—anus
app. an.—anal appendage
app. c.—appendage of branchial heart
atr.—ink sac
b. br., *b. branch*} gill base (branchial gland)
c.—heart
c. branch.—branchial heart
d. gen.—"anlage" of gonoducts
g. bucc. sup.—superior buccal ganglion
g. cer.—cerebral ganglion
g. opt.—optic ganglion
g. visc.—visceral ganglion
gen.—genital gland
hep.—liver
inf.—funnel
int.—mid-intestine
lig. an.—anal ligament
luc.—luminous organ
m.—margin of mantle
mu. add. inf.—funnel adductors
mu. coll.—collaris
mu. depr. inf.—funnel depressor
n. pall.—pallial nerve
nephr.—renal sac
oes.—esophagus
org. inf.—funnel organ
pancr.—pancreas
rad.—spiral folds
rect.—rectum
sacc.—visceral sac
sacc. v.—venous sac
saliv.—posterior salivary gland
st.—stomach
st.^{3}—appendage of stomach
st. coec.—caecum
st. comm.—sinus of stomach
ur.—papilla of renal sac
v. abd.—abdominal vein
v. branch.—branchial vein
v. c.—vena cava
v. hep.—hepatic vein
v. hep. sin.—left hepatic vein
v. pall.—pallial vein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v.abd.
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g.bacc.sup.
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g.visc.
saliv.
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Plate XLVIII

Cranchia LEACH, *Liocranchia* PFEFFER

Figure 1. *Cranchia scabra* LEACH. Large male from South Equatorial Current, Station 49 Drawn from a live specimen after a photograph and color sketch. Natural size

Figure 2. Same specimen, dorsal. Natural size

Figure 3. *Liocranchia valdiviae* n.sp. Adult male, dorsal. Indian North Equatorial Current near coast of East Africa. Station 258. × 2

Figure 4. Same specimen, ventral.

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Plate XLIX

Cranchia scabra LEACH

Figures 1–6. *Cranchia scabra*. Juvenile specimen from Indian North Equatorial Current (Station 217)

Figure 1. Dorsal view. × 5

Figure 2. Arms, ventral. Appr. × 20

Figure 3. Anterior part of body, showing the arms and the 3 points of fusion on mantle. Appr. × 12

Figure 4. Cartilaginous tubercle of mantle.

Figure 5. Posterior end of body with fins.

Figure 6. End of tentacle with club. Appr. × 30

Figure 7. Opened mantle cavity of large male of *Cranchia scabra* (cf. Plate XLVIII, Figures 1, 2).

The projecting liver is in the middle, rectum and anal appendages are situated on it. A ligament extends from the vena cava toward the anus. The vena cava circumscribes the liver on its right side in a wide curve. On each side behind the liver are the openings of the renal sacs. Gills and branchial hearts are situated at a large distance; they are surrounded anteriorly by the curved margin of the musculus depressor infundibuli (funnel depressor), which is transformed into a septum. The large branchial arteries and the abdominal veins extend toward the branchial hearts, the latter approaching them from behind. The opening of the male genitalia is situated in front of the left branchial heart (Figure 8). The funnel organ is folded, due to the strong contraction caused by preservation; the ventral wall of the funnel is displaced upward. In the posterior half of the body, the large caecum and, behind it, the stomach and the esophagus, which enters it, as well as the hepato-pancreatic duct are visible through the abdominal integument. The posterior artery passes over the middle of the abdominal wall; the very short mantle septum is attached to this artery.

Figure 8. Base of left gill of large male, showing branchial heart, veins and opening of genitalia. × 6

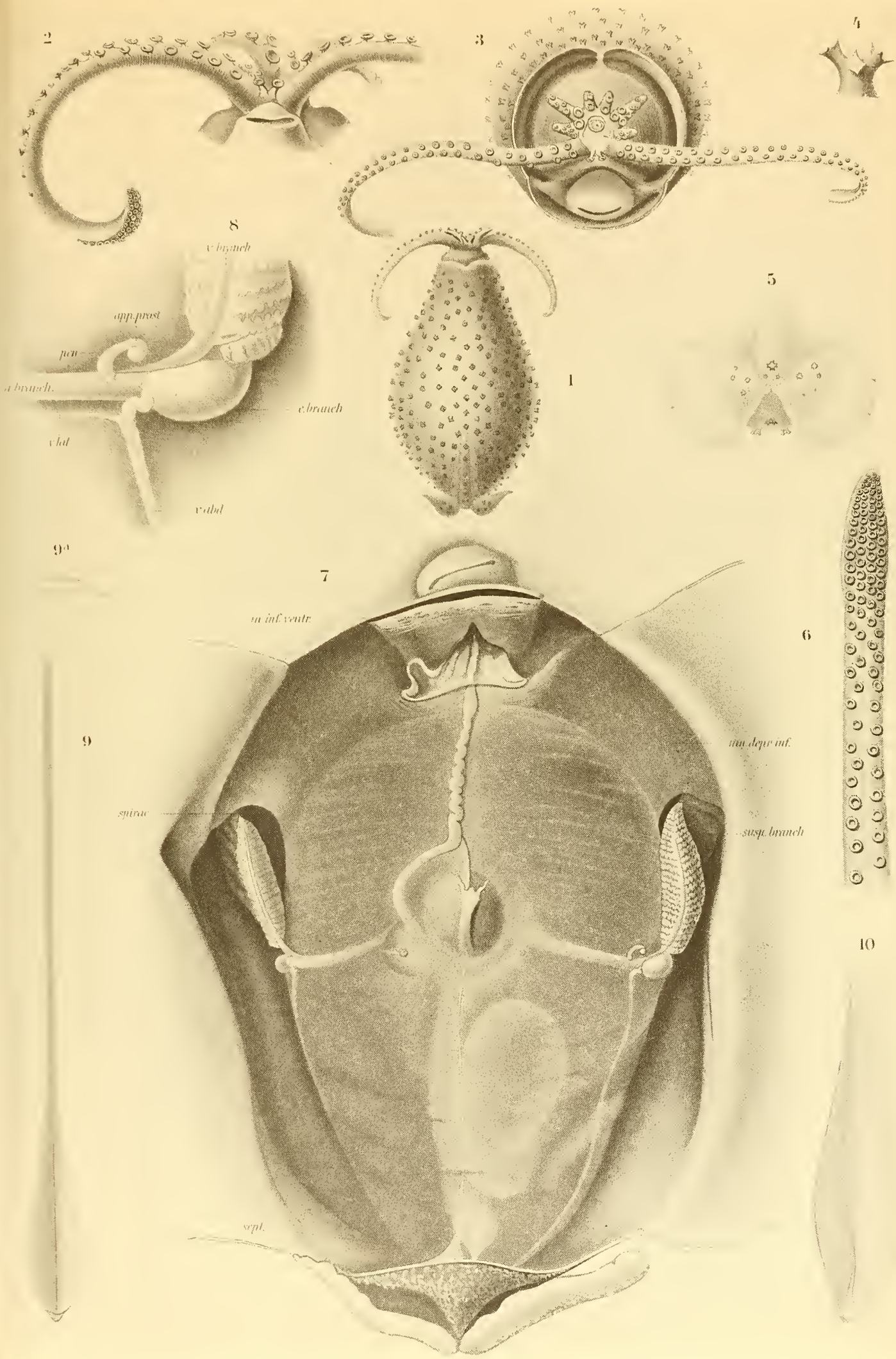
Figure 9. Gladius of medium-sized female of *Cranchia scabra*, ventral. × 3

Figure 9a. Cross section through anterior half of gladius.

Figure 10. Posterior end of same gladius, viewed diagonally from the side.

ABBREVIATIONS

a. branch.—branchial artery
app. prost.—appendage of prostate
c. branch.—branchial heart
m. inf. ventr.—ventral lamella of funnel
mu. depr. inf.—funnel depressor
pen.—penis (distal part of Needham's sac)
sept.—mantle septum
susp. branch.—branchial ligament
v. abd.—abdominal vein
v. branch.—branchial vein
v. lat.—lateral vein, opening into abdominal vein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mn. depr. inf.
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susp. branch
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Plate L

Anatomy of *Cranchia scabra*

Figure 1. Buccal funnel and arm apparatus, inner side. Large male from Station 49 with hectocotylized ventral arm. × 4

Figure 2. Outer side of tentacle club. Large male. × 4

Figure 3. Head and arms, right side (Based on the preserved large male). Eye completely covered by contracted lid membrane. × 3

Figure 4. Right eye with the 13 luminous organs (*1 . . . 13*), after removal of lid membrane. Large male. × 2.3

Figure 5. Right eye of medium-sized female with the 13 luminous organs (*1 . . . 13*). × 10

Figure 6. Intestinal tract, vascular system, gills and developing genitalia of medium-sized female, ventral surface. Liver and adjacent organs folded over upward, toward the front. × 7

Figure 7. Intestinal tract and vascular system of medium-sized female, right side. × 7

Figure 8. Dorsal half of liver and adjacent organs of the medium-sized female. Left side. × 7

Figure 9. Brain and eyes of medium-sized female, dorsal.

Figure 10. Stomach and ovary of medium-sized female, dorsal surface. × 7

Figure 11. Same as Figure 10, left side. × 7

Figure 12. Swellings and spiral folds of caecum, right side. Large male

Figure 13. Stomach and caecum, and adjacent gonad, of the large male, left side.

Figure 14. Posterior surface of liver with venous sacs, pancreas, and rectum. Medium-sized female. × 7

Figure 15. Gonoducts of large male, ventral surface. × 14

Figure 16. Same, dorsal surface. × 14

ABBREVIATIONS

a. branch.—branchial artery
a. ceph.—cephalic aorta
a. dors.—dorsal artery
a. hep.—hepatic artery
a. post.—posterior artery
amp.—ampulla of cephalic vein
app. an.—anal appendage
app. prost.—appendage of prostate
b. sperm.—spermatophore sac
c. branch.—branchial heart
d. hep.—hepatic duct
d. hep. pancr.—hepato-pancreatic duct
diaphr.—diaphragm
g. bucc. sup.—superior buccal ganglion
g. opt.—optic ganglion
g. pall.—pallial ganglion
hect.—hectocotylus
hep.—liver
inf.—funnel
int.—mid-intestine
ir.—iris
lam. ext.—outer membrane
lig. an.—anal ligament
lig. g. g.—gastro-genital ligament
n. ophth. sup.—superior ophthalmic nerve
n. pall.—pallial nerve
nid.—nidamental gland
oes.—esophagus
ovd.—oviduct
pancr.—pancreas
pen.—end of spermatophore sac
prost.—prostate
rad.—spiral folds
rect.—rectum
sacc.—sheath of male gonoducts
sacc. v. hep.—sac of hepatic vein
sacc. v. hep. ant.—anterior sac of hepatic vein
sacc. v. hep. post.—posterior sac of hepatic vein
st.—stomach
st. coec.—caecum
sulc.—groove of intestine
test.—testis
tub. olf.—olfactory tubercle
ur.—papilla of renal sac
v. abd.—abdominal vein
v. branch.—branchial vein
v. c.—vena cava
v. def.—vas deferens
v. dors.—dorsal vein
v. g. g.—gastric vein
v. pall.—pallial vein
vel.—sail-shaped stomach fold
ves. sem. 1, ves. sem. 2, ves. sem. 3—1st, 2nd, and 3rd part of seminal vesicle, respectively

Plate LI

Liocranchia. Anatomy and juvenile forms

Figure 1. Young larva, length 5.5 mm. Dorsal view of anterior half of head, Station 54. Guinea Current. × 20

Figure 2. Same larva, ventral. × 20

Figure 3. Head of youngest larva, length 4.5 mm, lateral. Station 226, central Indian Ocean. × 45

Figure 4. Youngest larva of *Cranchia scabra.* Anterior part of body, lateral. Station 54, Guinea Current. × 20

Figure 5. *Liocranchia reinhardtii.* Head of juvenile specimen, ventral. Total length: 20 mm (dorsal mantle length: 15 mm). The lid membrane forms a sac. Station 54, Guinea Current. × 15

Figure 6. *L. reinhardtii.* Arms of larva whose dorsal mantle length measures 7 mm. Station 64, near São Tomé. × 25

Figure 7. *L. reinhardtii.* Arm apparatus of medium-sized larva which measures 9 mm dorsal mantle length. Station 215. Bay of Bengal. × 18

Figure 8. *L. valdiviae.* Ventral arms of male from Station 239; dorsal mantle length 25 mm. Left ventral arm hectocotylized. Indian Countercurrent. × 15

Figure 9. *L. valdiviae.* Ventral arms of large male: dorsal mantle length 40 mm (cf. Plate XLVIII, Figures 3 and 4). Left ventral arm hectocotylized. Station 258, East African coast. × 15

Figure 10. *L. valdiviae.* Arm apparatus of male measuring 22 mm dorsal mantle length. Station 182, Indian South Equatorial Current. × 10

Figure 11. *L. valdiviae.* Club of large male, outer surface. Station 258. × 18

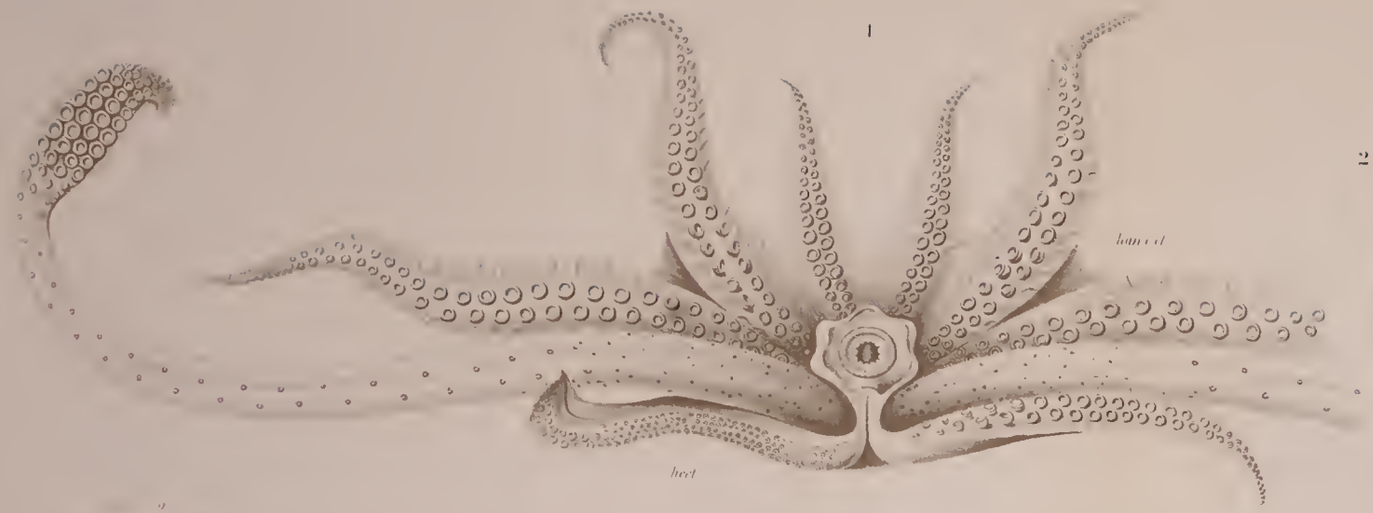
Figure 12. *L. valdiviae.* Tentacle of large male. Station 258. × 12

Figure 13. *L. valdiviae.* Inner organs of the large male from Station 258, ventral. × 8

Figure 14. *L. valdiviae.* Stomach with opened caecum. Station 258

ABBREVIATIONS

a. branch.—branchial artery
a. ceph.—cephalic aorta
an.—anus
c. branch.—branchial heart
hect.—hectocotylus
hep.—liver
lig. g. g.—gastro-genital ligament
oes.—esophagus
pancr.—pancreas
pen.—end of spermatophore sac (penis)
sacc. v. hep. a.—anterior sac of hepatic vein
sacc. v. hep. p.—posterior sac of hepatic vein
spir.—spiral winding of esophagus, intestine and hepato-pancreatic duct
st.—stomach
st. coec.—caecum
sulc.—groove to caecum
ur.—papilla of renal sac
v. c.—vena cava
vel.—stomach sail
ves. sem.—seminal vesicle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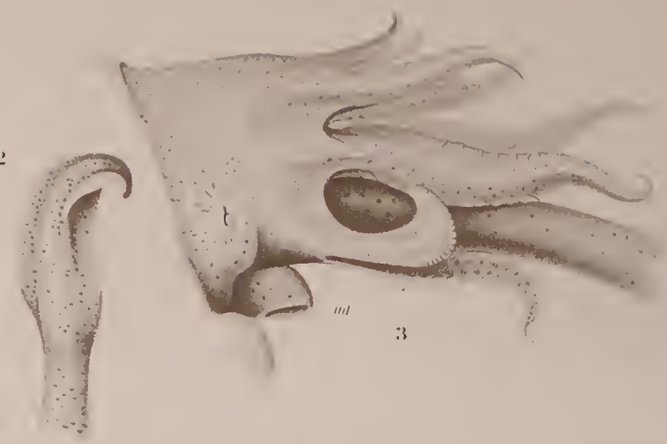
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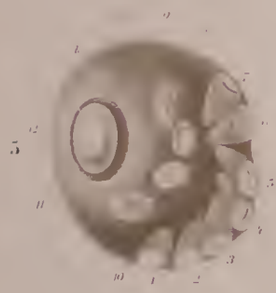
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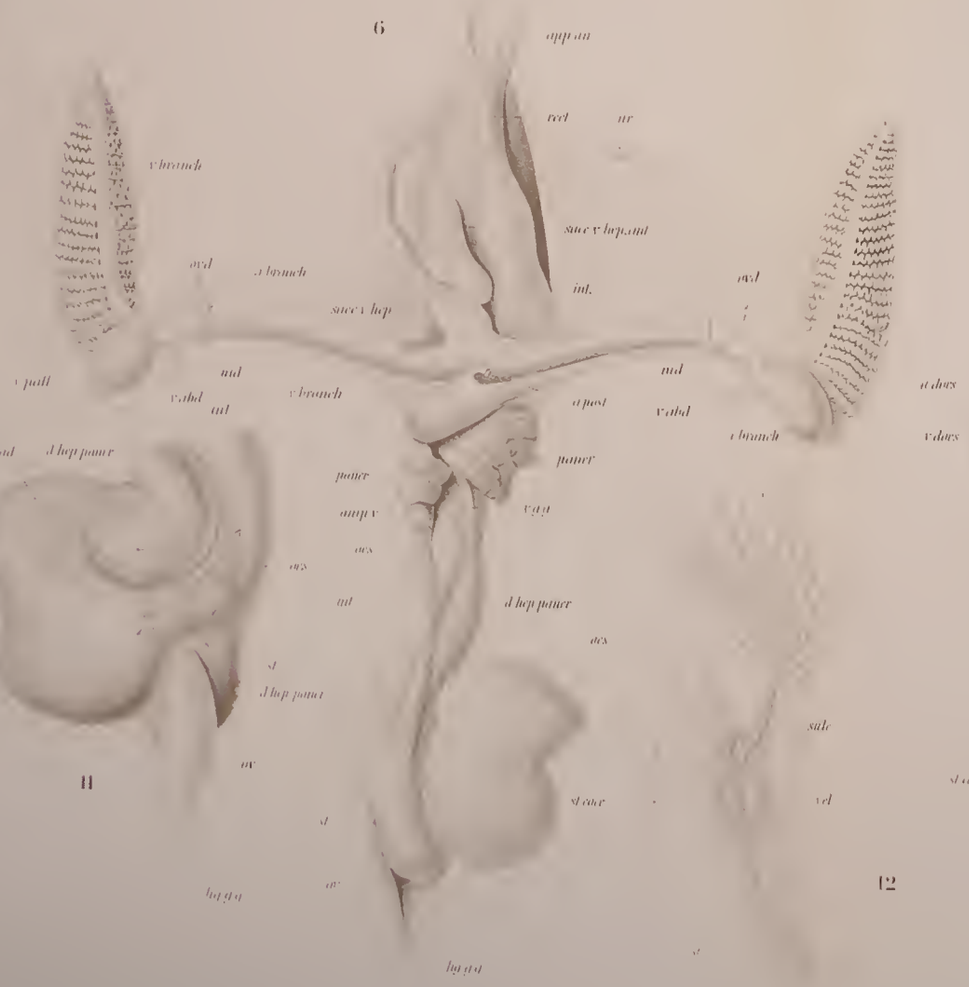
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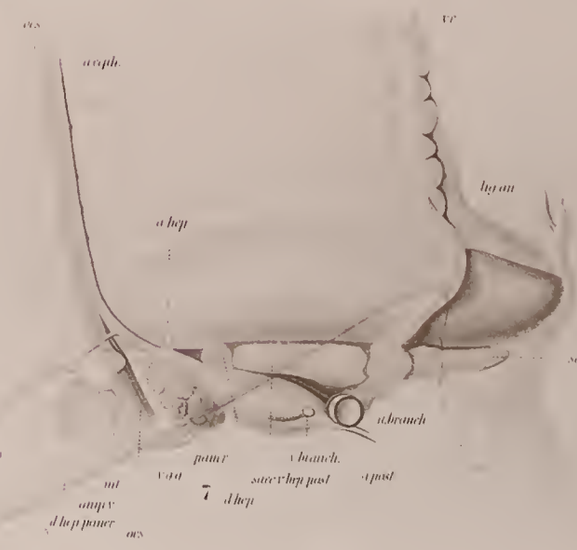
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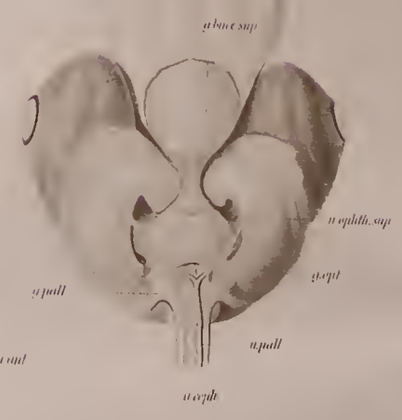
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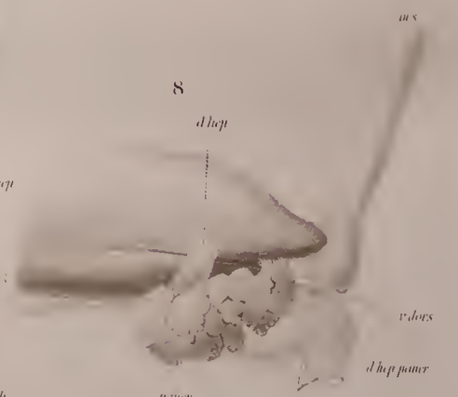
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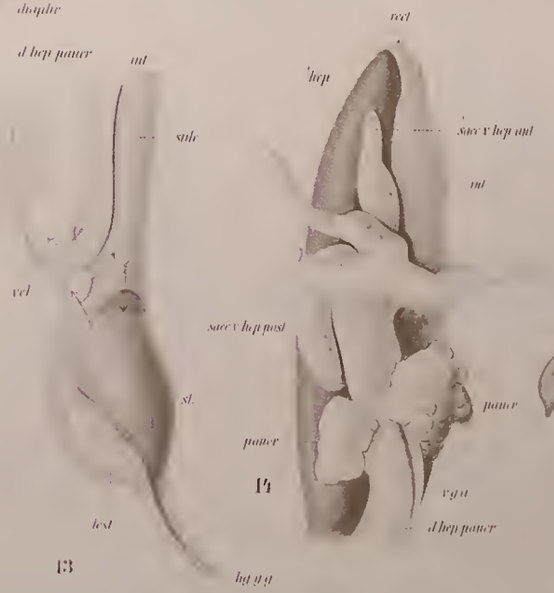
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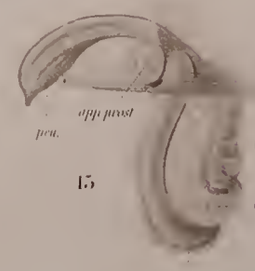
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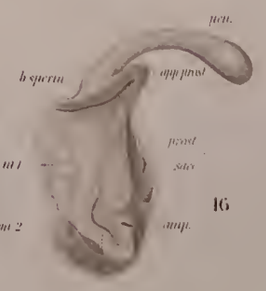
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Plate LII

Euzygaena, Leachia

Figures 1–3. *Euzygaena pacifica* Iss., male

Figure 1. Ventral. Sagami Bay. × 2
Figure 2. Right club. × 17
Figure 3. Ventral arms. Right ventral arm hectocotylized. × 25

Figures 4–7. *Leachia eschscholtzii* Rathke. Near Borneo

Figure 4. Mature female. Mantle complex. × 4
Figure 5. *Leachia eschscholtzii* Rathke, female. Anatomy of the internal organs, ventral
Figure 6. Openings of stomach and caecum with pancreas, ventral
Figure 7. Cap of caecum and pancreas.

ABBREVIATIONS

a. branch.—branchial vein
a. dors.—dorsal artery
a. g. g.—gastric artery
a. hep.—hepatic artery
a. post.—posterior artery
an.—anus
app. an.—anal appendages
branch.—gill
d. hep. c.—single hepatic duct
d. hep. d.—right hepatic duct
d. pancr.—pancreatic ducts
g. visc.—gastric ganglion
gl. od. d.—right oviduct gland
gl. od. s.—left oviduct gland
hep.—liver
int.—intestine
lig. an.—anal ligament
lig. g. g.—gastro-genital ligament
nid. d.—right nidamental gland
nid. s.—left nidamental gland
oes.—esophagus
ov.—ovary
or. od.—opening of oviduct gland
pancr.—pancreas
rad.—spiral folds
rect.—rectum
st.—stomach
st.'—narrowed part of stomach
st. coec.—caecum
sulc.—groove to caecum
ur.—papilla of renal sac
v. c.—vena cava
vel.—stomach sail

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Plate LIII

Desmoteuthis, *Crystalloteuthis* n.gen.

Figure 1. *Desmoteuthis pellucida* CHUN. Drawn after the live animal. Station 90, Benguela Current. Natural size

Figures 2–9. *Crystalloteuthis glacialis* n.gen. n.sp. Station 145, Antarctic Ocean

Figure 2. *Cryst. glacialis*. Drawn after the live animal. Dorsal. × 2
Figure 3. Same, ventral. Drawn after the preserved specimen. × 2
Figure 4. Arms, dorsal. × 12
Figure 5. Outer side of tentacle. × 10
Figure 6. Inner side of tentacle. × 10
Figure 7. Head and funnel, ventral. Lid membrane of right eye removed. Mantle opened
Figure 8. Left ventral tubercle.
Figure 9. Dorsal tubercle.

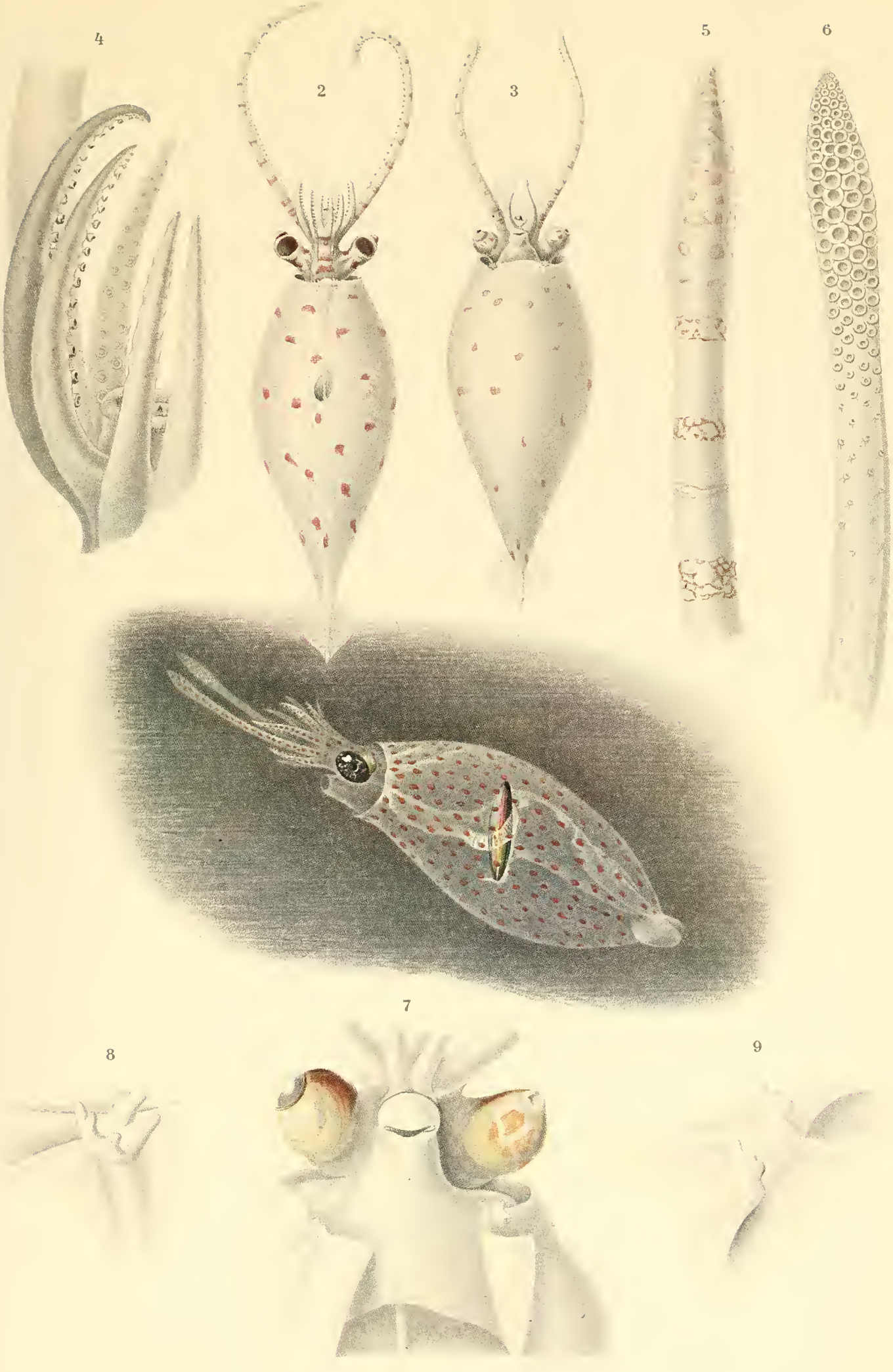
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Plate LIV

Desmoteuthis and *Crystalloteuthis*. Anatomy

Figures 1–17. *Desmoteuthis pellucida*

Figure 1. Arm apparatus and buccal funnel, viewed from above. × 3
Figure 2. Outer side of club of tentacle with protective membranes and swimming membrane. × 9
Figure 3. Head and arms of the preserved specimen, diagonally from above. × 4.5
Figure 4. Larger sucker of tentacle club.
Figure 5. Larger sucker of arm, dried out.
The whitish, calcified indentations of the margin and the plates of the inner chitinous layer are distinct
Figure 6. Olfactory tubercle, in profile.
Figure 7. Right eye. Ventral view, showing both luminous organs. × 4.5
Figure 8. Same eye, broad side. Lid fold contracted to form a slit
Figure 9. Cross section of mantle, showing musculature; homog.imm. 1/12, ocular No. 2.
Figure 10. Longitudinal section of mantle; homog. imm. 1/12, ocular No. 2.
Figure 11. Nuclei of outer epithelium of mantle; homog.imm. 1/12, ocular No. 2.
Figure 12. Visceral complex and vascular system, right side.
Figure 13. Cross section of viscera anterior to caecum (in direction of arrow, Figure 12).
Figure 14. Viscera, heart, and large vessels, viewed from posterior side of liver.
Figure 15. Same preparation as in Figure 14; heart and right pancreatic duct removed.
Figure 16. Caecum with opening of pancreatic duct, left side.
Figure 17. Stomach, caecum, and adjacent parts opened.
Figure 18. *Crystalloteuthis glacialis*. Viscera, heart, and large vessels, right side

ABBREVIATIONS

a. branch.—branchial artery
a. ceph.—cephalic aorta
a. dors.—dorsal artery
a. hep.—hepatic artery
a. pancr.—pancreatic artery
a. post.—posterior artery
amp. v.—ampulla of cephalic vein
an.—anus
app. an.—anal appendages
atr.—ink sac
bg.—connective tissue of cutis
c.—heart
d. hep. pancr.—hepato-pancreatic duct
diaphr.—diaphragm
ek.—ectoderm
g. gastr.—gastric ganglion
gen.—gonad
hep.—liver
inf.—funnel
int.—mid-intestine
lam. int.—inner marginal lamella of mantle
lam. rad.—lamella of radial fibers
lig. an.—anal ligament
lig. g. g.—gastro-gential ligament
luc. ant.—anterior luminous organ
luc. post.—posterior luminous organ
mu. circ.—ring muscles
mu. rad.—radial muscles
nu. circ.—nuclei of ring muscles
nu. rad.—nuclei of radial muscles
oes.—esophagus
ov.—ovary
p. inf.—inner funnel of renal sac
pancr.—pancreas
rect.—rectum
sacc. v. ant.—anterior venous sac
sacc. v. g. g.—sac of gastric vein
sacc. v. hep.—sac of hepatic vein
sacc. v. post.—posterior venous sac
st.—stomach
st. coec.—caecum
st. str.—striated part of stomach
str.[1]—larger swellings
sulc.—groove to caecum
tub. olf.—olfactory tubercle
ur.—papilla of renal sac
v.—vein of caecum
v. branch.—branchial vein
v. c.—vena cava
v. ceph.—cephalic vein
v. cord.—cardiac vein
v. dors.—dorsal vein
v. g. g.—gastric vein
v. pancr.—pancreatic vein

Plate LV

Corynomma speculator n.gen. n.sp

Figure 1. Specimen from Station 237, Indian South Equatorial Current. Dorsal, × 3
Figure 2. Same specimen, ventral. × 3
Figure 3. Head and arms, dorsal. Appr. × 11
Figure 4. Arms, viewed diagonally from above. Appr. × 15
Figure 5. Eye, lateral. × 15
Figure 6. Eye, diagonally dorsal. × 15
Figure 7. Tentacle, inner surface. Appr. × 28
Figure 8. Tentacle, outer surface.
Figure 9. Tentacle of older specimen from Atlantic South Equatorial Current. Appr. × 12.

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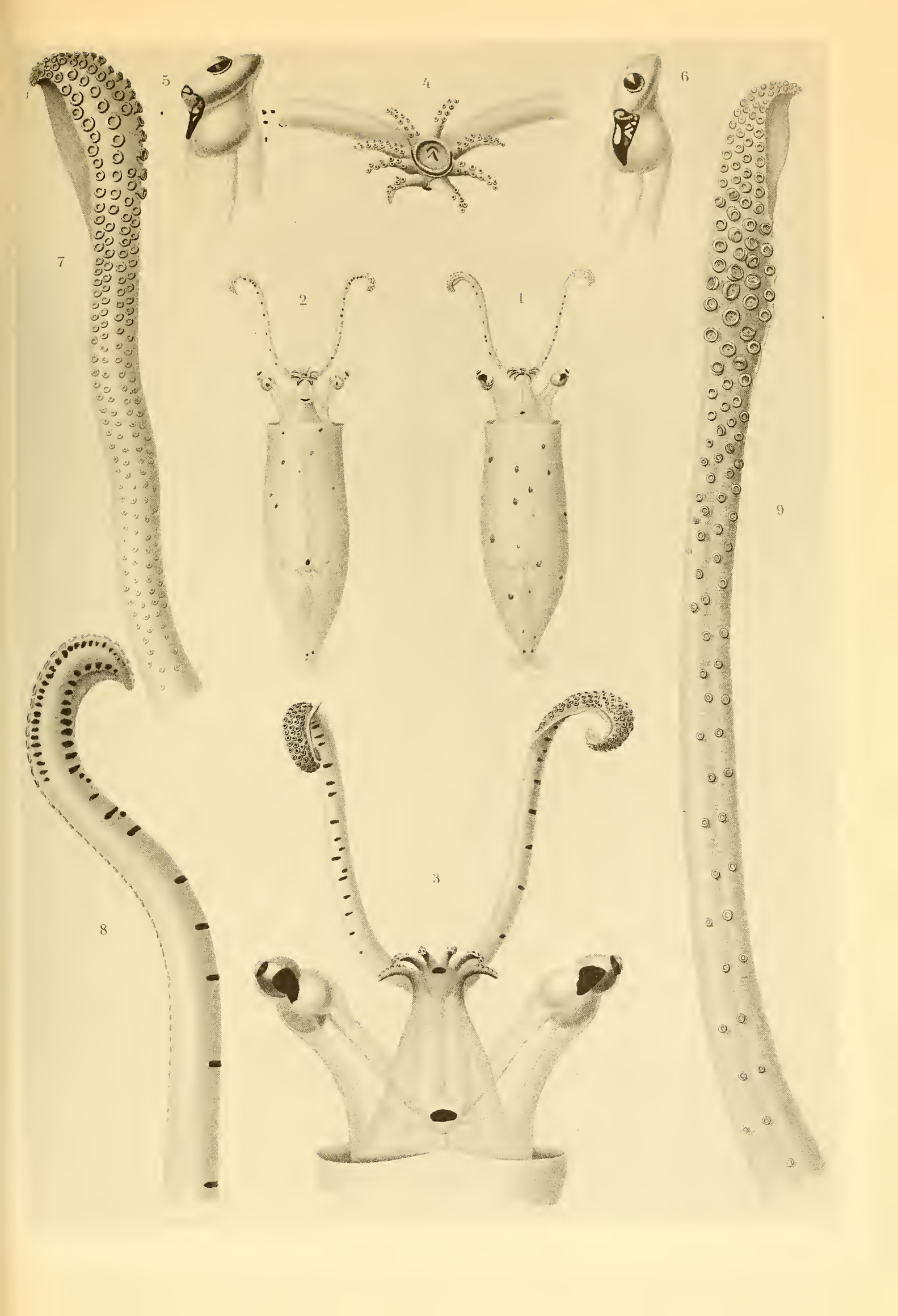
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Plate LVI

Teuthowenia, *Sandalops*, *Toxeuma*, *Bathothauma*

Figures 1–5. *Teuthowenia antarctica* n.sp.

Figure 1. Dorsal view of specimen from Station 136. Antarctic Ocean. × 4
Figure 2. Same specimen, ventral. × 4
Figure 3. Anterior part of body, ventral. × 14
Figure 4. Eye, viewed diagonally from above. × 14
Figure 5. Left eye, precisely lateral. × 17

Figures 6–8. *Sandalops melancholicus* n.gen. n.sp.

Figure 6. *Sandalops melancholicus*, right side. Southern Atlantic. × 8
Figure 7. Posterior end of body with fins. Appr. × 10
Figure 8. Anterior part of the body, ventral. Appr. × 16
Figure 9. Left eye of *Bathothauma*, diagonally lateral. Eye stalk constricted by preservation. × 7
Figure 10. Right eye of *Toxeuma*, lateral. × 9

ABBREVIATIONS

cart.—cartilage of ventral corner of mantle
con.—conus of eyeball
g. opt.—optic ganglion
inf.—funnel
luc.—luminous organ
n. ophth. inf.—inferior ophthalmic nerve
n. ophth. sup.—superior ophthalmic nerve
n. opt.—optic nerve

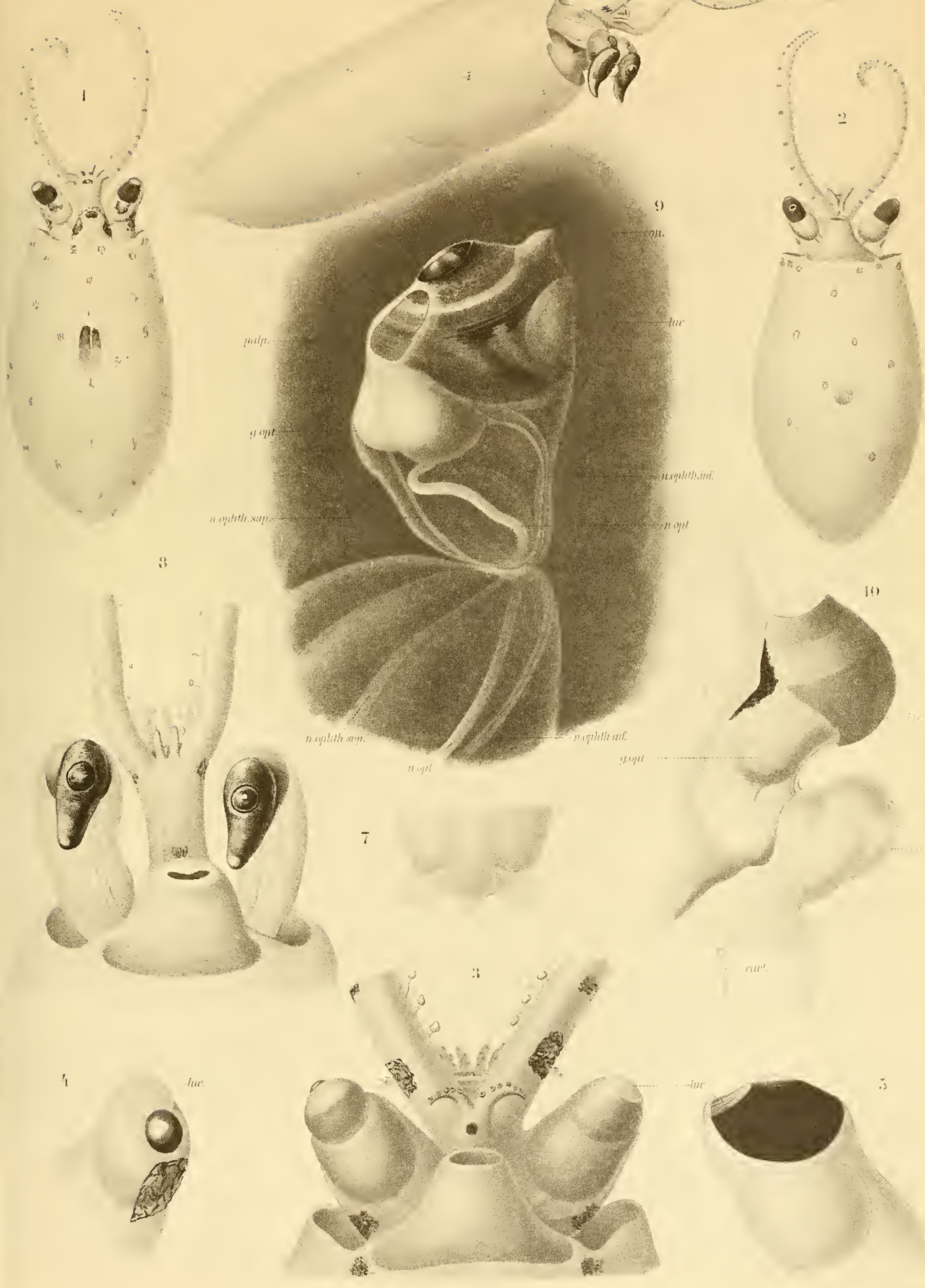
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Plate LVII

Bathothauma, *Teuthowenia*

Figure 1. *Bathothauma lyromma* n.gen. n.sp. Mantle complex, ventral. × 4.5
Figure 2. *Bathothauma*. Heart, major vessels and adjacent organs. × 8.
Liver displaced forward

Figures 3–7. *Teuthowenia antarctica* n.sp. Station 137, Antarctic Ocean

Figure 3. Tentacle, lateral. × 15
Figure 4. Tentacle, inner surface. × 15
Figure 5. Arms and buccal funnel. × 20
Figure 6. Mantle complex, left side (after clearing in oil of cloves).
Figure 7. Mantle complex and left gill, ventral surface.

ABBREVIATIONS

a. branch.—branchial artery
a. post.—posterior artery
an.—anus
app. an.—anal appendages
atr.—ink sac
c.—heart
c. branch.—branchial heart
cer.—brain
d. coel.—inner funnel of renal sac
d. hep. pancr.—hepato-pancreatic duct
g. opt.—optic ganglion
g. stell.—stellate ganglion
hep.—liver
inf.—funnel
int.—mid-intestine
lig.—ligament of liver
luc.—luminous organ
nephr.—renal sac
oes.—esophagus
org. inf.—funnel organ
ov.—ovary
pancr.—pancreas
sacc.—visceral sac
sacc. ven.—venous sac
saliv.—posterior salivary gland
spirac.—spiraculum
st.—stomach
st.^{1}—anterior part of stomach
st.^{2}—middle part of stomach
st.^{3}—end part of stomach
st. coec.—caecum
stat.—static organ
susp. branch.—branchial ligament
ur.—papilla of renal sac
v. branch.—branchial vein
v. c.—vena cava
v. hep.—hepatic vein
v. pall.—pallial vein
y.—narrow part of viscera sac with posterior end of stomach

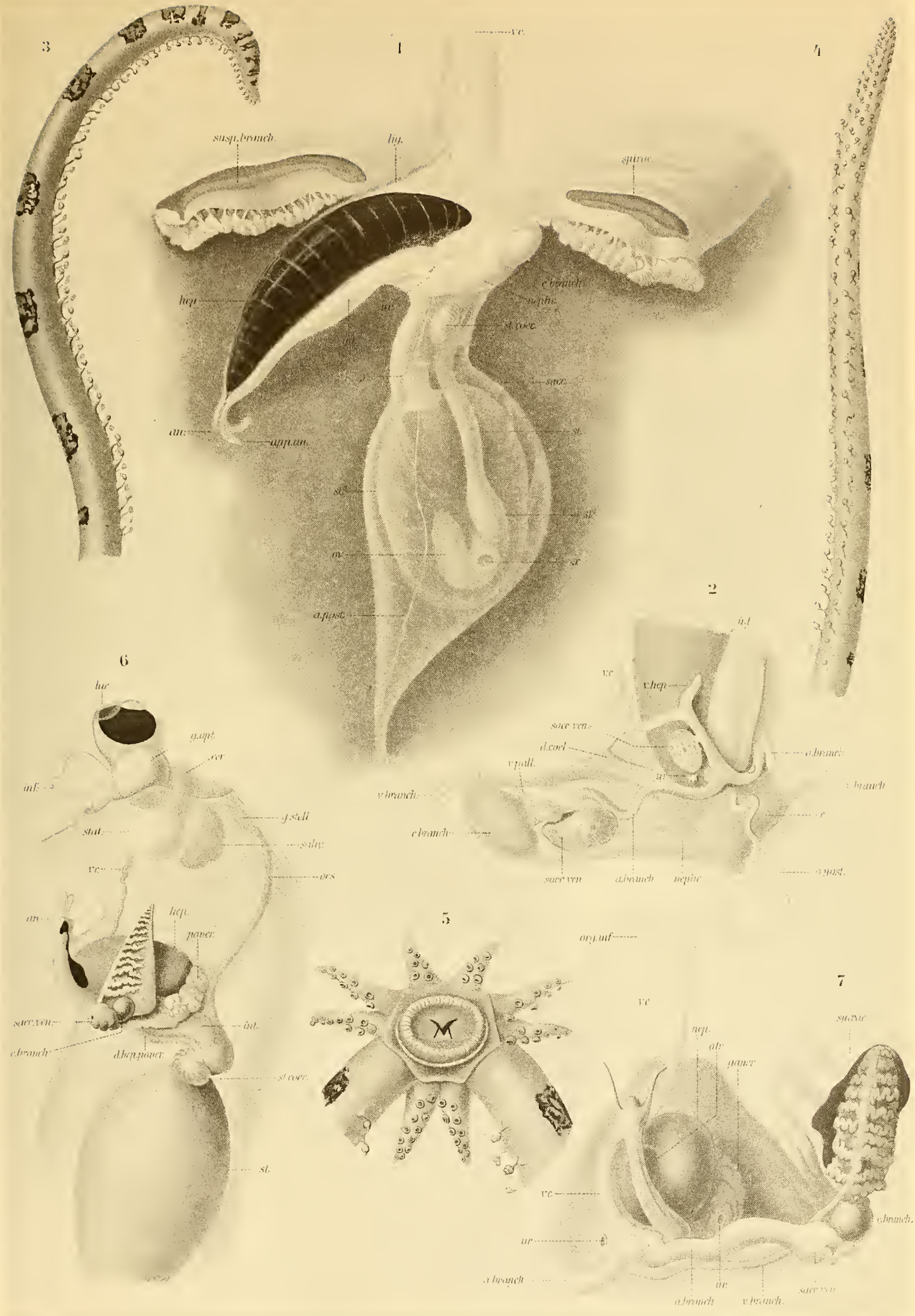
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Plate LVIII

Toxeuma, *Bathothauma*

Figures 1–5. *Toxeuma belone* n.gen. n.sp.

Figure 1. *Toxeuma belone*. Station 182, Indian South Equatorial Current. × 2
Figure 2. Same specimen, ventral. × 2
Figure 3. Anterior part of body, ventral. Appr. × 8
Figure 4. Tentacle club, outer surface. × 25
Figure 5. Tentacle club, inner surface. × 25

Figures 6, 7. *Bathothauma lyromma* n.gen. n.sp.

Figure 6. *Bathothauma lyromma*, female. Natural size. Atlantic North Equatorial Current. Ventral. Eye stalks presented are constricted by preservation
Figure 7. Same specimen, dorsal. Natural size. Eye stalks drawn after another specimen—extended

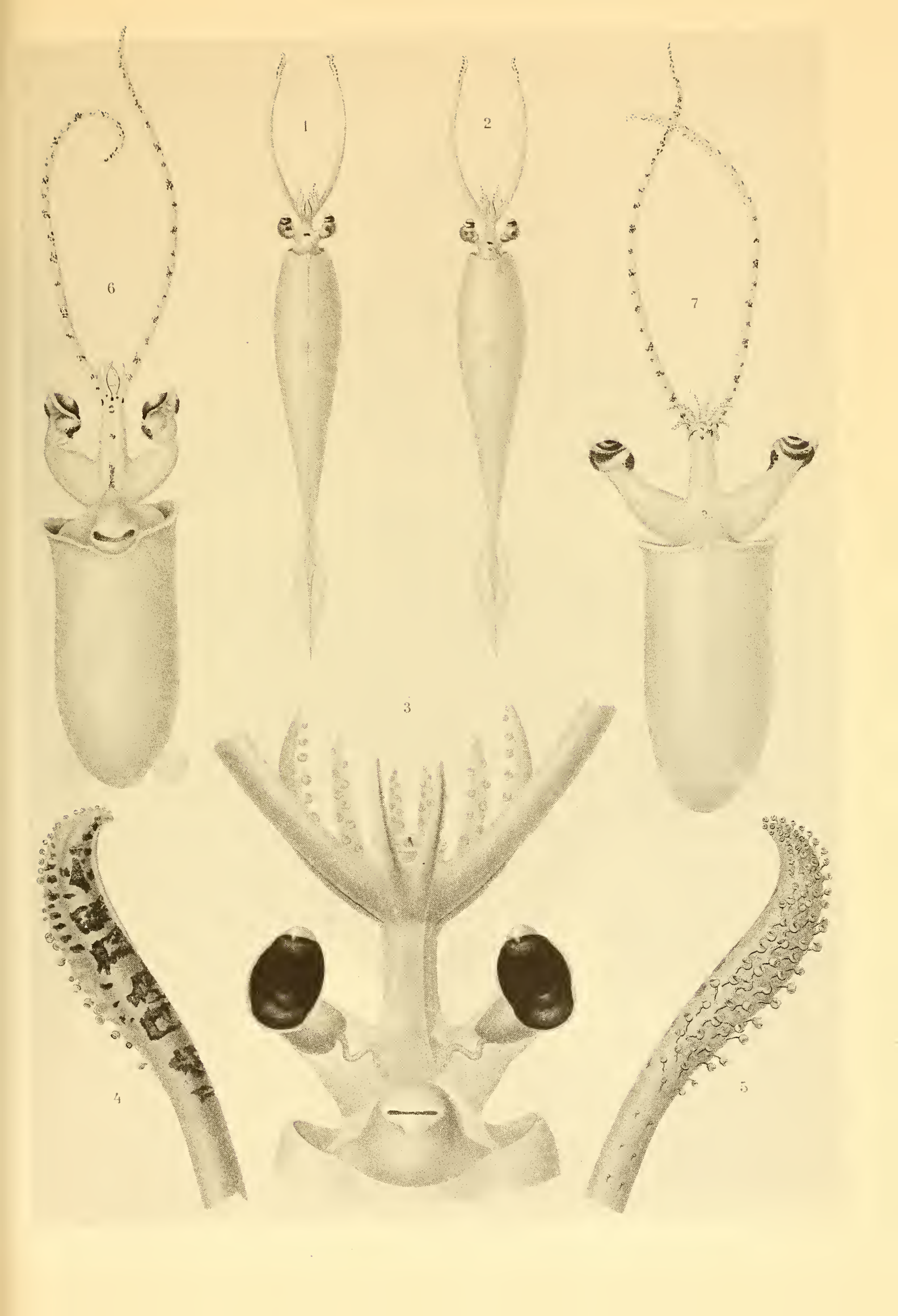
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Plate LIX

Galiteuthis (*Taonidium*)

Figure 1. *Galiteuthis suhmii* HOYLE (*G. armata* JOUBIN), dorsal. Station 51, Guinea Current. Natural size

Figure 2. Same specimen, ventral.

Figure 3. *Galiteuthis* (*Taonidium*) *suhmii*. Juvenile form, dorsal. Station 43, Guinea Current. × 2

Figure 4. Same specimen, ventral.

Figure 5. Right club of adult specimen. Appr. × 20

Figure 6. Right club of juvenile form (*Taonidium*). × 15

Figure 7. Club of juvenile form, lateral.

Figure 8. Third and 4th arm of juvenile form, and base of tentacle, left side. Appr. × 24

Figure 9. Arms and buccal funnel of juvenile form. Appr. × 24

Figure 10. Arms and buccal funnel of adult. × 2

Figure 11. Eye of adult specimen, ventral, showing luminous organ (*luc.*) and olfactory tubercle.

Plate LX

Luminous organs of the Cranchiidae

Figures 1–6. *Cranchia scabra*

Figure 1. Median section through organ No. 3 (cf. Plate L, Figure 5). Sublimate, iron-hematoxylin. × 120
Figure 2. Median section through organ No. 11. × 120
Figure 3. Median section through organ No. 12. × 120
Figure 4. Part of luminous body of organ No. 3. Homog. imm. 1/12, ocular No. 2, prism
Figure 5. Transition of the luminous body of organ No. 2 into the body epithelium. Homog. imm. 1/12
Figure 6. Cell from bottom of reflector.

Figures 7–11. *Liocranchia valdiviae*

Figure 7. Eye with the 4 organs, lateral. Lid fold removed, but olfactory tubercle situated outside the lid fold is shown. × 12
Figure 8. Median section of a luminous organ. × 100
Figure 9. Luminous body: transition of the finely granulate cells into the pale, vacuolated cells. Homog. imm., ocular No. 2, prism
Figure 10. Concentrically stratified luminous cells from bottom of luminous body. Homog. imm. 1/12, ocular No. 2, prism. Acid carmine
Figure 11. Transition of the luminous cells into the body epithelium. Homog. imm. 1/12, ocular No. 2, prism

Figure 12. *Leachia eschscholtzii*

Figure 12. Median section of organ No. 2.

Figures 13–17. *Corynomma speculator*

Figure 13. The two organs on the ink sac; rectum and adjacent region.
Figure 14. Longitudinal section through an organ (parallel to median plane). × 120
Figure 15. Cross section of ink sac and luminous organ situated on it. Posterior region
Figure 16. Same series of cross sections as in Figure 15, anterior region. Ocular No. 2, prism
Figure 17. Luminous cells and capillaries. Homog. imm. 1/12, ocular, prism

Figures 18–24. *Desmoteuthis pellucida*

Figure 18. Median section through double organ of eye, with marginal part of retina and the epithelial body. Formol, hemalum
Figure 19. Border zone between cells of luminous body and fibrous cells of lens. Homog. imm. 1/12, ocular No. 2, prism
Figure 20. Luminous cells after staining with iron-hematoxylin. Homog. imm. 1/12, ocular No. 2, prism
Figure 21. Cells of luminous body and capillaries. Hemalum

Figure 22. *Bathothauma lyromma*

Figure 22. Median section through luminous organ of *Bathothauma*. × 72
In the course of preservation, the luminous organ detached itself from eyeball and bent outward; in life it is convex and adheres closely to the eyeball.

ABBREVIATIONS

a. post.—posterior artery
an.—anus
atr.—ink sac
bg.—connective tissue
branch—gill
c. cil.—ciliated body
c. hep.—capsule of connective tissue of liver
cap.—capillaries
cart.—eye cartilage
ek.—ectoderm
fibr.—fibers of connective tissue
gel.—gelatinous body
hep.—liver
ir.—iris
lim.—cells of membrana limitans
luc. ant.—anterior luminous organ
luc. post.—posterior luminous organ
m. l.—membrana limitans
mu. cil.—ciliary muscle
nu. cap.—nuclei of capillaries
nu. phot.—nuclei of luminous cells
nu. str.—nuclei of lens fibers
phot.—luminous body
phot. centr.—central luminous cell
pulv.—pad
refl.—reflector
res.—reservoir of ink sac
s. ven.—marginal vein
s. z.—cells of retina
spec.—mirror
st.—rods
str.—fibers of lens
tub. olf.—olfactory tubercle
ur.—papilla of renal sac
v.—vessels
ven.—vein

Plate LXI

Larvae of Cranchiidae

Figure 1. Juvenile larva from Station 102 (Agulhas Current). Ventral. × 10
Figure 2. Same larva, lateral. × 10

Figures 3–5. Juvenile larva from Guinea Current, Station 41 (*Euzygaena?*)

Figure 3. Lateral. × 10
Figure 4. Ventral. × 10
Figure 5. Head, dorsal. Appr. × 30
Figure 6. Larva of *Corynomma*, caught in locking net at 100–200 m. Station 143, Antarctic Drift Current. Ventral. × 10
Figure 7. Larva of *Teuthowenia antarctica*. Station 135, Antarctic Drift Current. Diagonally ventral. × 10
Figure 8. Tentacle of the larva from Station 135 (Figure 7). Appr. × 40
Figure 9. Older larva of *Taonidium* (*Galiteuthis*). Station 64, Atlantic Ocean, near São Tomé. × 6
Figure 10. Tentacle of the larva from Station 64 (Figure 9). Appr. × 20

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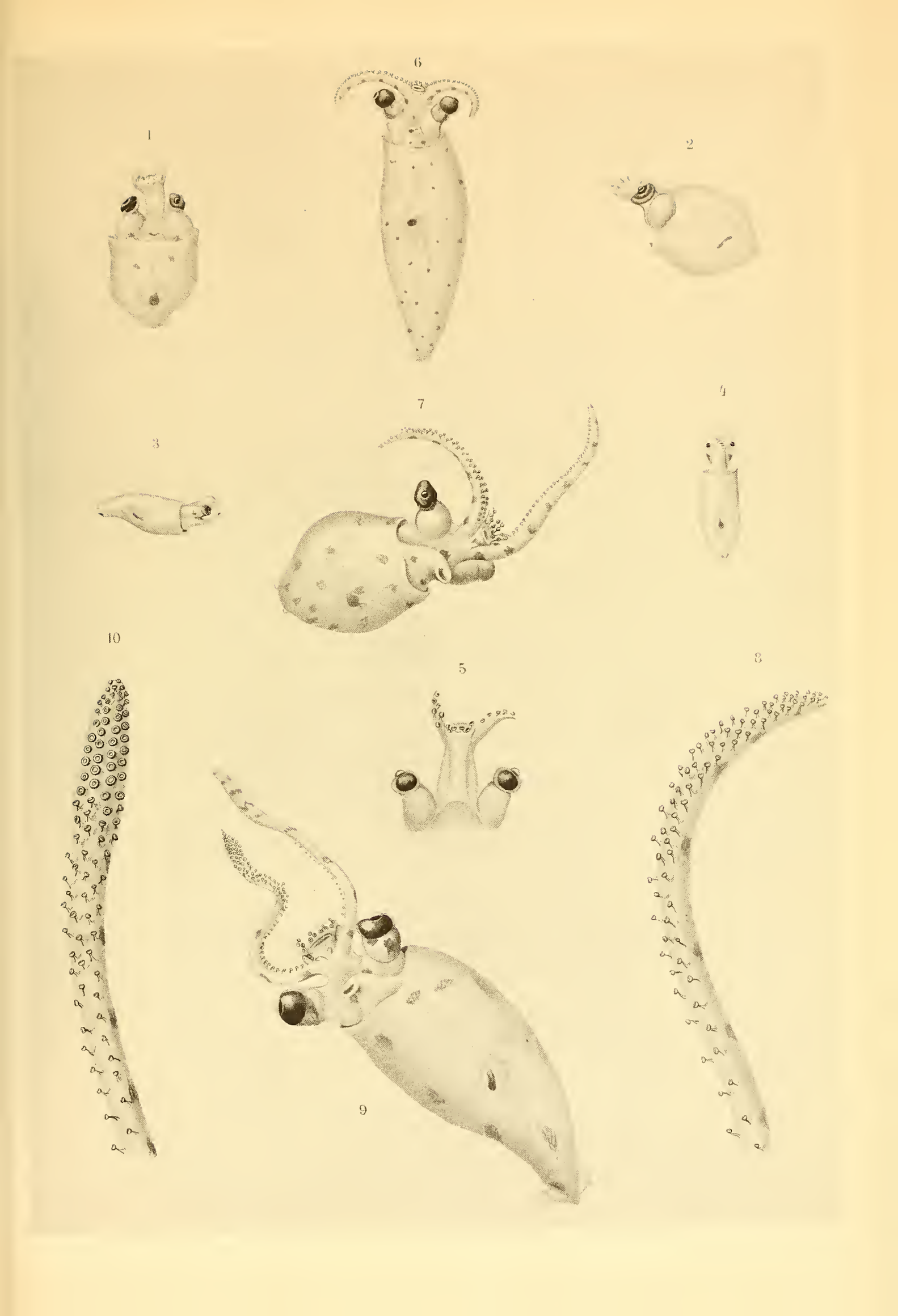
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Carl Chun

THE CEPHALOPODA

PART II: MYOPSIDA, OCTOPODA

ATLAS

GERMAN DEEPSEA EXPEDITION 1898–1899. VOL. XVIII, PART II

WISSENSCHAFTLICHE ERGEBNISSE

DER

DEUTSCHEN TIEFSEE-EXPEDITION

AUF DEM DAMPFER „VALDIVIA“ 1898-1899

IM AUFTRAGE DES REICHSAMTES DES INNERN

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MIT 39 ABBILDUNGEN IM TEXT UND 34 TAFELN

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VERLAG VON GUSTAV FISCHER

1915

Eingegangen im März 1914, C. Chun

PLATES

Plate LXII

Rossia mastigophora n. sp.

Station 253. Indian North Equatorial Current near the East African coast. Trawl, 638 m

Figure 1. Female, dorsal view. Natural size
Figure 2. Same, ventral view. Natural size
Figure 3. Same, diagonally from the left. Natural size

From color sketches of the live animal

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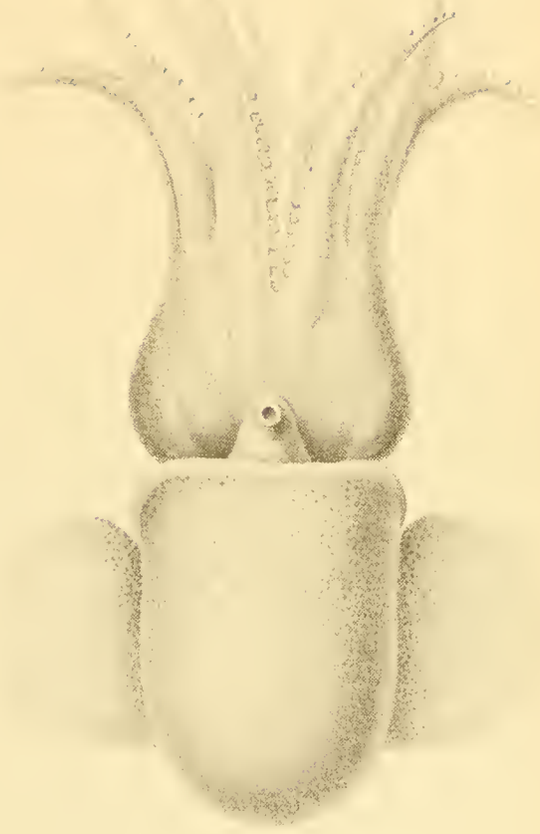

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Plate LXIII

Rossia mastigophora n. sp.

Station 253

Arm Apparatus and Mantle Complex

Figure 1. Arm apparatus of male. × 3. *I* — dorsal arms; *IV* — ventral arms; *t* — cut tentacle. Suckers partly lost

Figure 2. Club of female. × 5

Figure 3. Neck cartilage and left eye of female; collaris folded at right of neck cartilage.

Figure 4. Mantle complex of male.

Figure 5. Mantle complex of female.

Figure 6. Funnel cartilage and mantle complex of female.

ABBREVIATIONS

depr. inf. — funnel depressors
gl.', gl.'' — glands of unknown nature in the mantle cavity
nid. — nidamental gland
nid. acc. — accessory nidamental gland
olf. — olfactory organ
org. inf. — funnel organ
ov. — ovary
pen. — penis
sept. — mantle septum
t — tentacle
ur. — renal papilla

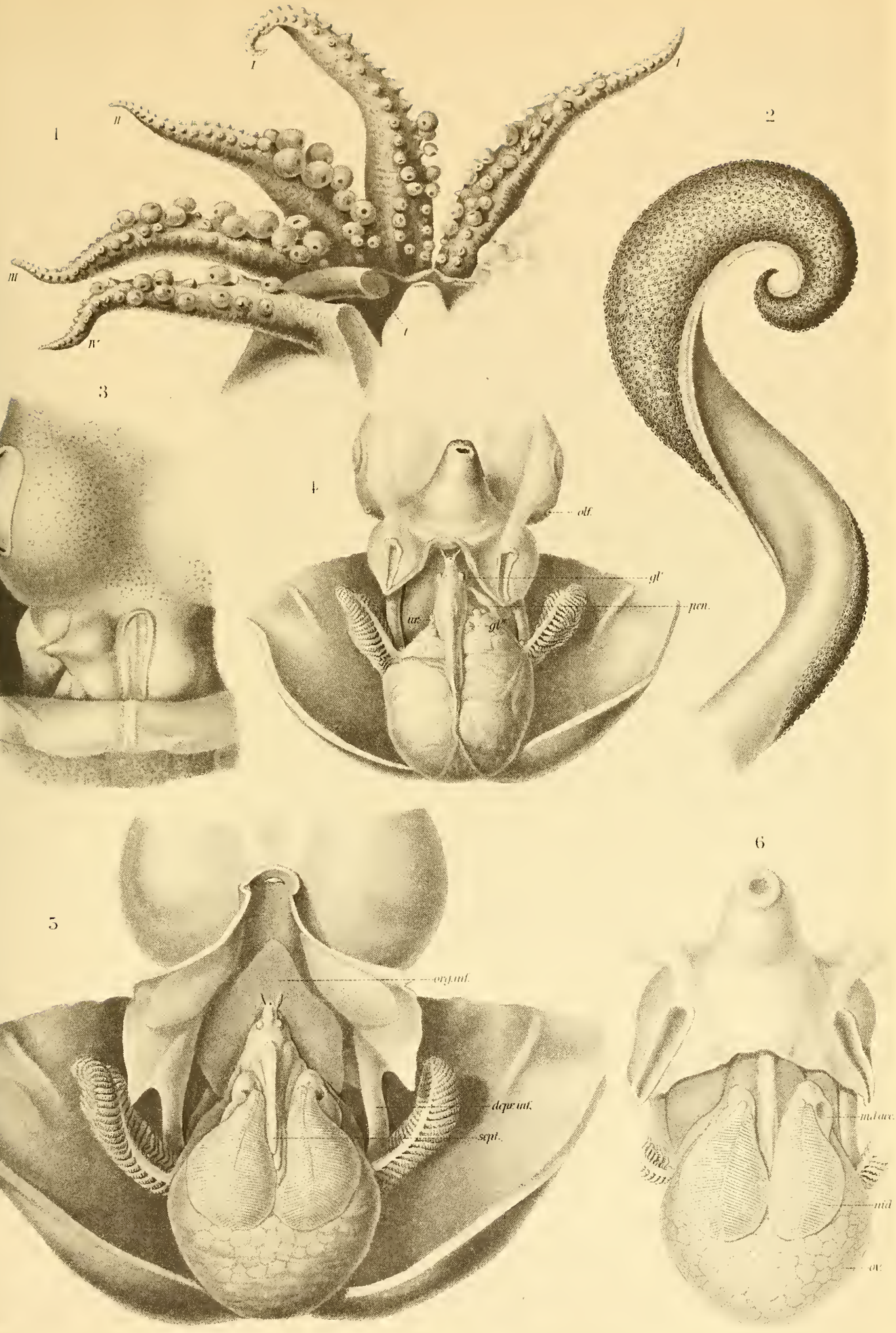
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Plate LXIV

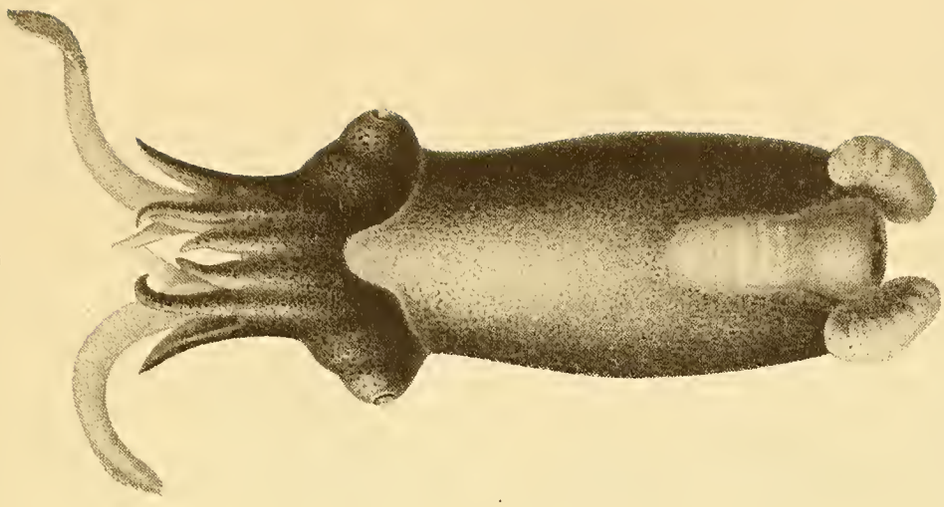
Spirula australis LAM.

Station 195. Nias South Canal

Figure 1. Female, diagonally from the ventral side. × 2. Color sketch after the live animal; chromatophores on mantle chafed off by the trawl.

Figure 2. Same, dorsal view. × 2. Coloration of mantle completed

Figure 3. Terminal disc with fins. × 2



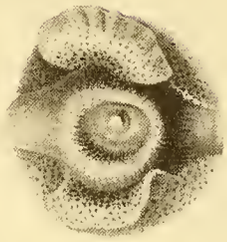


Plate LXV

Spirula australis LAM.

Station 195

Mantle Complex and Arm Apparatus

Figure 1. Female with opened mantle cavity. × 2
Figure 2. Mantle complex obliquely from the left; left nidamental glands removed. × 2
Figure 3. Neck cartilage; dorsal corner of mantle folded back. × 3
Figure 4. Funnel (opened) with funnel organ. × 3
Figure 5. Inner view of spread arms and tentacles.
Figure 6. Left club.

ABBREVIATIONS

depr. inf. — funnel depressors
nid. acc. — accessory nidamental gland
olf. — olfactory organ
org. inf. funnel organ
ov. —ovary
ovd. —oviduct
rect. —rectum
ur. — renal papilla

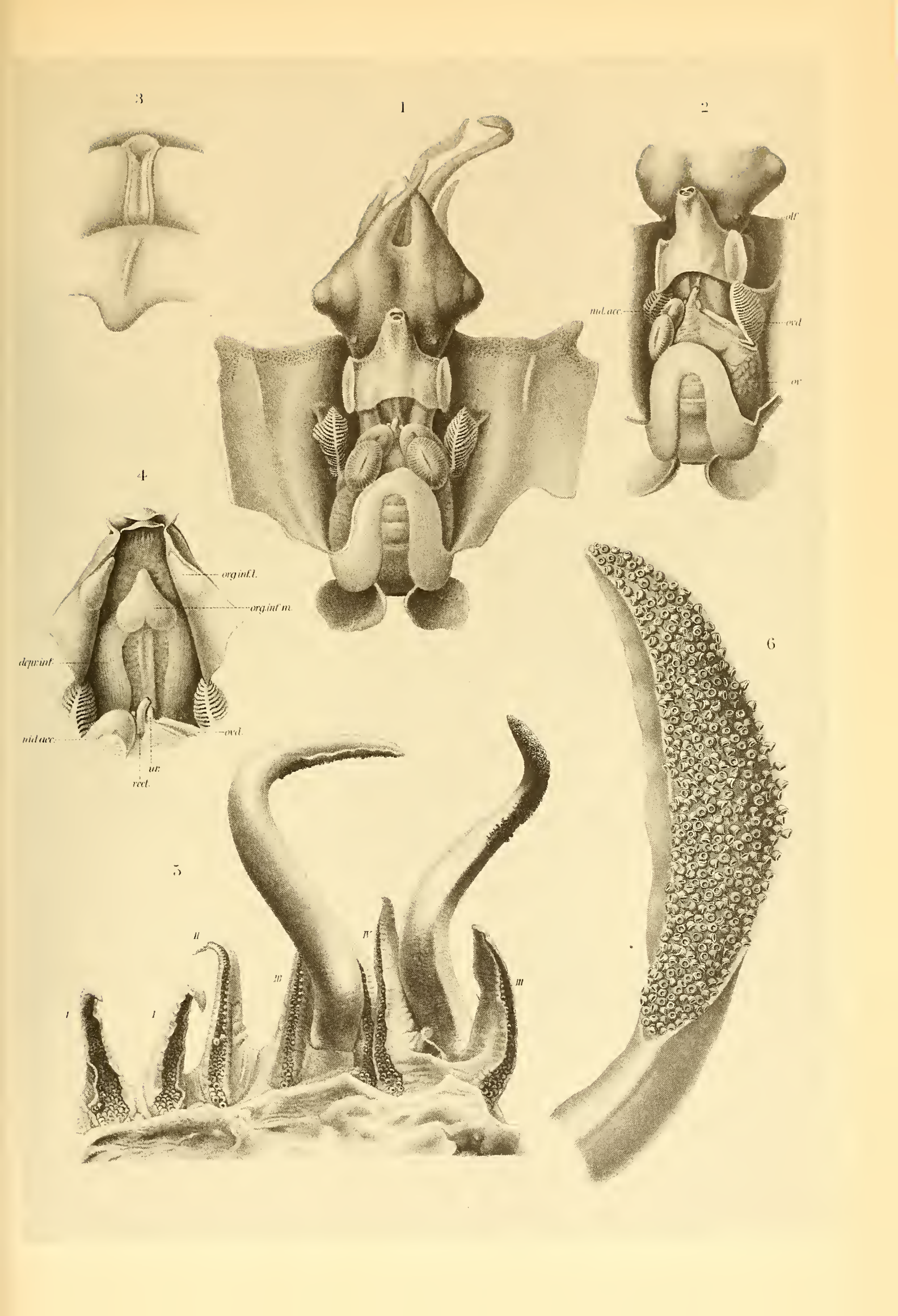

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Plate LXVI

Spirula australis

(Printed from photographs)

Figure 1. *Spirula*, dorsal view.
Figure 2. *Spirula*, right side.
Figure 3. Opened mantle cavity. Left nidamental glands removed and left posterior part of mantle folded down. Shell opened to show siphonal necks. Ventral view.
Figure 4. Mantle complex, slightly diagonally from the left. Left nidamental gland removed

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Plate LXVII

Spirula australis

(Printed from photographs)

Figure 1. Semidiagrammatic presentation of *Spirula*, from the right. Mantle and shell cut in half; posterior end of body, which is shown transparent, covered by right fin. Extent of dorsal and ventral ovals indicated by fine contours (*d.*, *v.*)

Figure 2. Mantle complex, ventral view. Shell opened to show siphonal necks; nidamental glands removed and funnel opened by longitudinal cut. Abdominal wall removed above intestine and right half of visceral sac

Figure 3. Mantle complex after removal of renal sac and vascular system.

ABBREVIATIONS

an. — anus
app. — appendage of branchial heart
br. — gills
cart. — funnel cartilage
cbr.—branchial heart
coll. —collaris
d. — contours of dorsal oval
inf. — funnel
luc. —luminous organ
mu. depr. — musculi depressores infundibuli
mu. hep. — muscular capsule of liver
nephr. — communication between the two renal sacs behind intestine
nuch. — neck cartilage
ov. —ovary with eggs at different stages of development
ov.'—right lobe of ovary behind stomach
ovd., ovd.' — oviduct
rect. — rectum
sacc. —shell sac
sacc. st. — sac of caecum
sipho — siphuncle
st. — richly vascularized envelope of caecum (spiral stomach)
ur. — renal papilla
v. — contours of ventral oval
ven. — venous appendages

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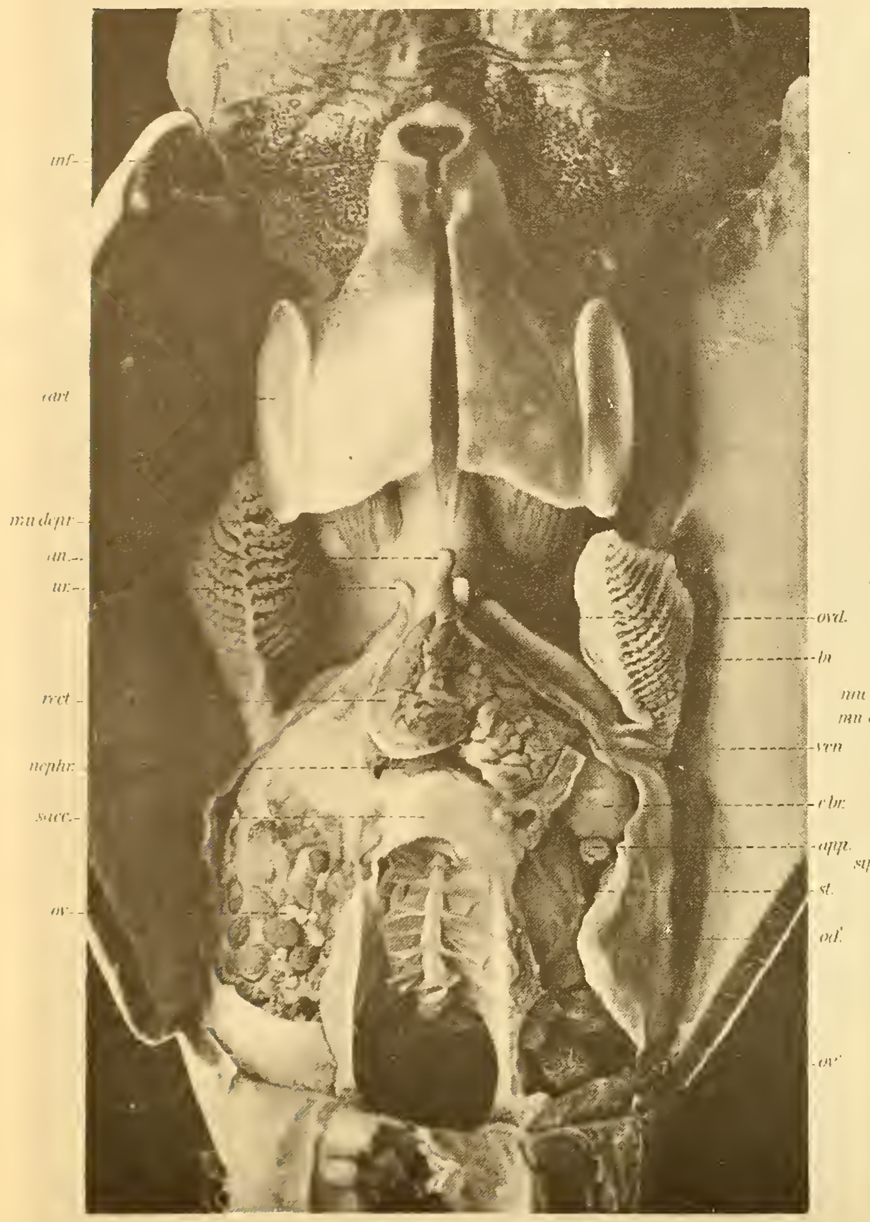
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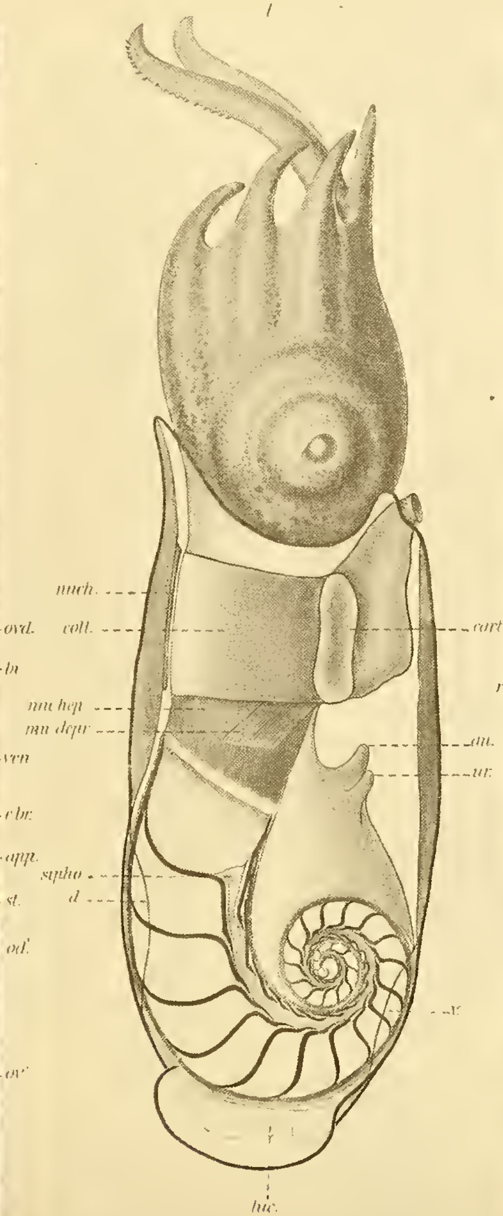
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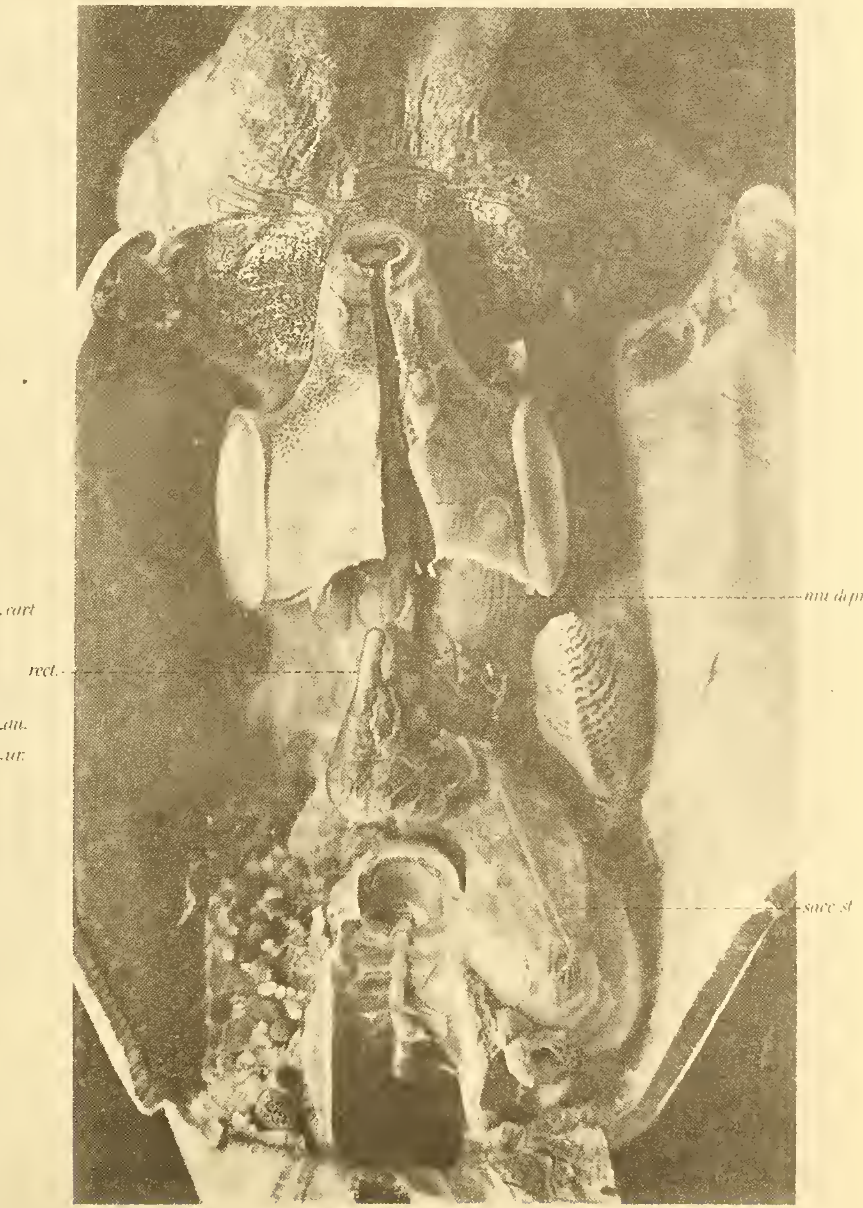
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Plate LXVIII

Spirula australis

Intestinal Tract

Figure 1. Liver, stomach, rectum and ovary, ventral. Caecum and pancreas with their envelope

Figure 2. Liver, pancreas and rectum diagonally from the left side. Envelope of caecum and pancreas cut open

Figure 3. Upper view of transversely cut muscular envelope of liver and living chamber.

Figure 4. Halves of liver, spread to show esophagus and aorta. Caecum and pancreas shown with their envelope. Dorsal view

Figure 5. Intestinal tract in a cleared preparation, ventral view; liver folded aside.

Figure 6. Unpaired part of pancreas with collecting duct.

Figure 7. Posterior salivary gland, from the posterior; cross sections of salivary duct, esophagus and aorta shown in the dorsal groove.

Figure 9. Upper (*a*) and lower (*b*) jaw, lateral view; *c* — lower jaw, upper view. × 5.5.

ABBREVIATIONS

a. ceph. — arteria cephalica
atr. — ink sac
d. hep. pancr. — hepatic duct
d. saliv. — duct of salivary gland
g. gastr. — gastric ganglion
hep. — liver
int. — mid-intestine
lig. g. g. — gastro-genital ligament
oes. — esophagus
ov. — ovary
pancr. — pancreas
rect. — rectum
s. st. coec. — sac of caecum
st. — stomach
x — constriction

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Plate LXIX

Spirula australis LAM.

Nervous System and Sensory Organs

Figure 1. Anterior part of body, from the right. Mantle folded dorsally and separated by a cut from the shell sac. Only penultimate septa of shell exposed; rest of shell removed. Eyelid cut and folded back in 4 corners

Figure 2. Longitudinal section through eye with adjacent optic ganglion.

Figure 3. Section through retina with adjacent cartilage.

Figure 4. Brain with nerves from the right.

Figure 5. Supraesophageal ganglion.

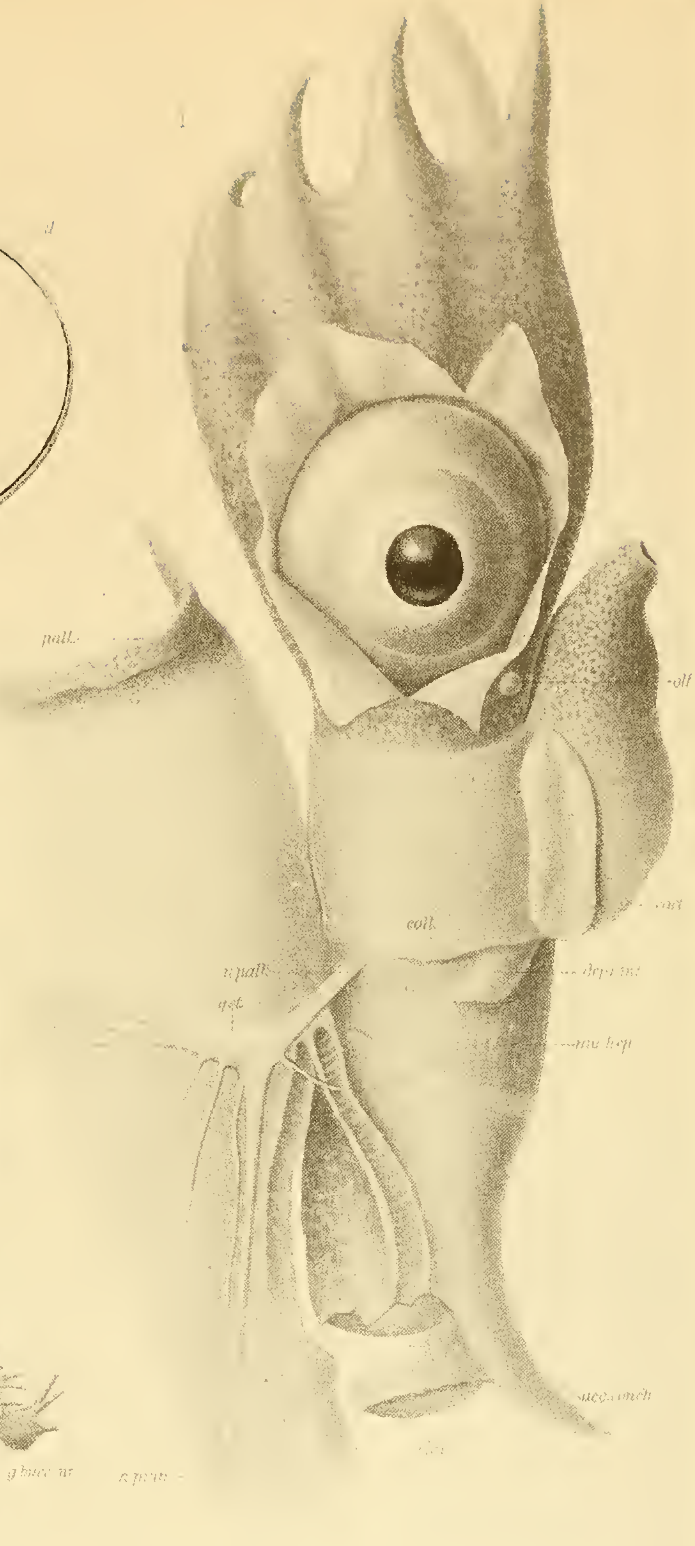
Figure 6. Right supra- and infraesophageal ganglia, lateral view.

Figure 7. Statolith, from the broad and from the narrow side.

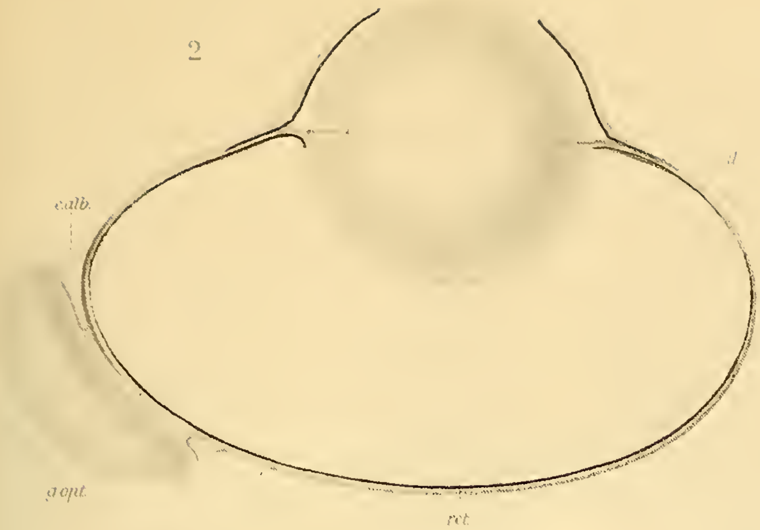
ABBREVIATIONS

c. alb. — white body
cam. — chamber
cart. — cartilage
c. brach. — commissura brachialis
c. cil. — ciliary body
c. cer. b.—commissura cerebr. buccale
coll. — collaris
depr. inf.—musculi depressores infundibuli
g. brach. — ganglion brachiale
g. bucc. inf.—ganglion buccale inferius
g. bucc. sup.—ganglion buccale superius
g. cer. — ganglion cerebrale
g. opt. — ganglion opticum
g. ped. — ganglion pedale
g. st. — ganglion stellatum
g. visc. — ganglion viscerale
ir. — iris
lim. — membrana limitans
mu. hep. — muscular sheath of liver
n. a. o. inf.—nervus antorbitalis inferior
n. a. o. s.—nervus antorbitalis superior
n. coll. — nervus collaris
n. inf. — nervus infundibuli anterior
n. olf. — nervus olfactorius
n. ophth. s.—nervus ophthalmicus superior
n. opt. — nervus opticus
n. pall. — nervus pallialis
n. pinn. — nervus pinnalis
n. p. o. — nervus postorbitalis
n. retr. cap. a.—nervus retractor capitis anterior
n. stat. — nervus staticus
n. tent. — nervus tentacularis
n. visc. — nervus visceralis
olf. — olfactory tubercle
pall. — mantle
pg. — pigment layer
ret. — retina
s. — layer of sensory cells
sacc. conch. — shell sac
st. — rods

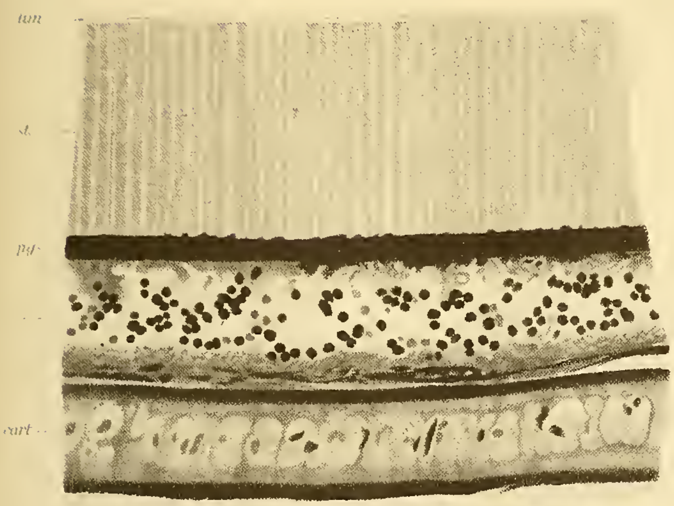
1


pall.
olf
coll.
n.pall.
n.pall
g.st

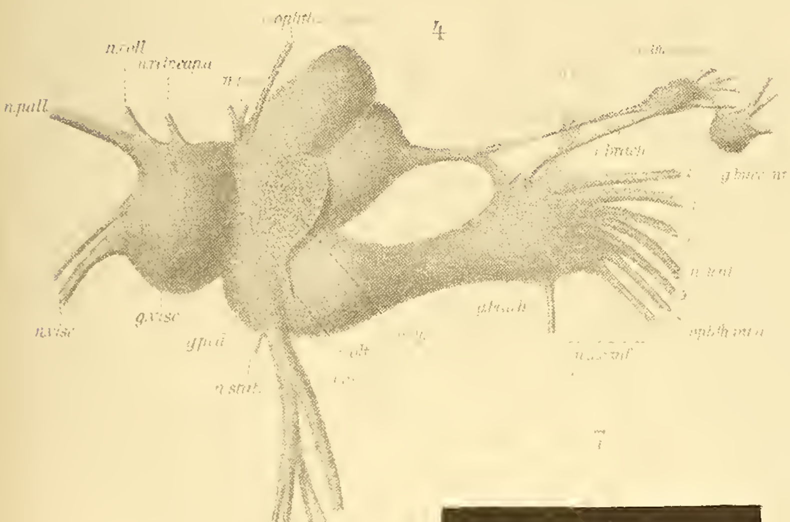
2


calb.
g.opt.
ret.

3


cart.

4


n.coll
n.pall.
n.visc
g.visc
n.stat.
g.brach

5

6

g.bucc.inf.
g.bucc.sup.

7

Plate LXX

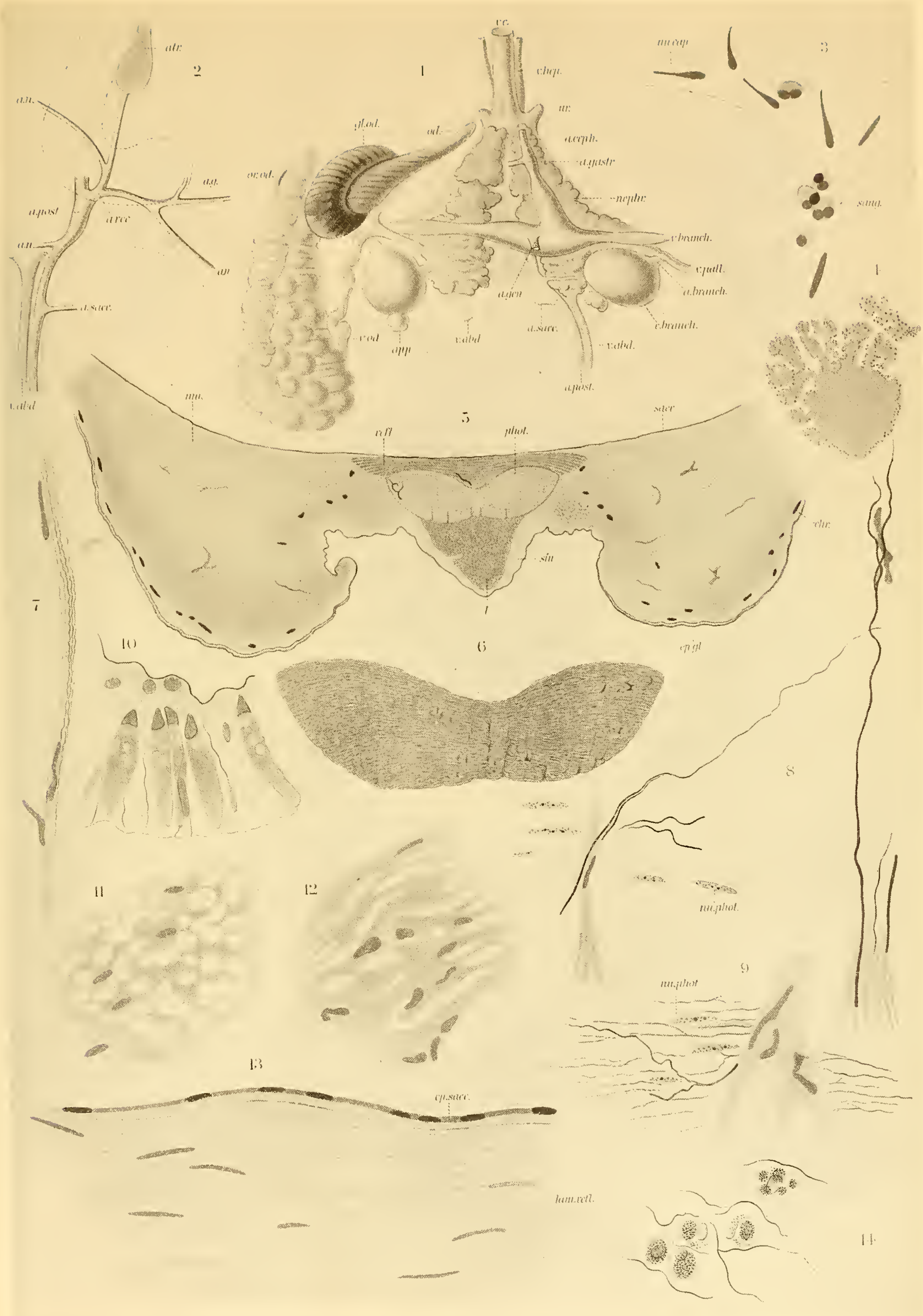
Spirula australis LAM.

Vascular System, Oviducts, Luminous Organs

Figure 1. Oviducts, renal sac and vascular system, dorsal view.
Figure 2. Branching of arteria posterior and arteria recurrens, ventral view. Intestine shown by dotted line.
Figure 3. Capillary vessel with blood corpuscles from the luminous body.
Figure 4. Cross section of vena genitalis anterior to its entrance into the renal sac.
Figure 5. Radial section of terminal disc with the luminous organ.
Figure 6. Luminous body.
Figure 7. Nerve from luminous body. Fibrils stained with iron hematoxylin. Zeiss, homogeneous immersion
Figure 8. Nerve branching in luminous body, with thicker and finer fibrils. Iron hematoxylin. Zeiss, homogeneous immersion
Figure 9. Large nerve radiating into luminous body, with nuclei and stained efferent fibrils. Iron hematoxylin. Zeiss, homogeneous immersion
Figure 10. Glandular epithelium of terminal disc. Zeiss, homogeneous immersion.
Figure 11. Lens tissue from vicicinity of luminous body. Zeiss, homogeneous immersion
Figure 12. Lens tissue from periphery. Zeiss, homogeneous immersion
Figure 13. Tissue of bars of reflector. Zeiss, homogeneous immersion
Figure 14. Cells with pigment clusters, from cutis of terminal disc. Zeiss, homogeneous immersion.

ABBREVIATIONS

a. branch. — arteria branchialis
a. ceph. — aorta cephalica
a. g.—branch of arteria recurrens to intestine
a. gastr. — arteria gastrica
a. gen. — arteria genitalis
a. n. — branches to renal sacs
a. post. — aorta posterior
a. pp.—appendages of branchial hearts
a. rec. — arteria recurrens
a. sacc. — branch to shell sac
atr. — ink sac
c. branch. — branchial heart
chr. — chromatophores
ep. gl. — epithelium of body
ep. sacc. — epithelium of shell sac
gl. od. — oviduct gland
l — terminal knob
lam. refl. — layer of reflector
mu. — muscles
nephr. — renal sacs
nu. cap. — nuclei of capillaries
nu. phot.—nuclei of central body of luminous organ
od. — oviduct
ov. od. — opening of oviduct
phot. — central body of luminous body
refl. — reflector
sacc. — shell sac
sang. — blood corpuscles
sin. — blood sinus
ur. — renal papilla
v. abd. — vena abdominalis
v. branch. — vena branchialis
v. c. — vena cava
v. hep. — vena hepatica
v. od. — vein of oviduct
v. pall. — vena pallialis



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10
11
12
13
14
atr.
a.n.
a.g.
a.post
a.rec
a.sacc.
v.abd
v.c.
gl.od.
od.
a.ceph.
a.gastr
v.branch.
v.pall.
a.branch.
c.branch.
a.gen
v.od
v.abd.
a.post.
sang.
mu.
phot.
sin
nu.phot.
ep.sacc.
lam.cell.

Plate LXXI

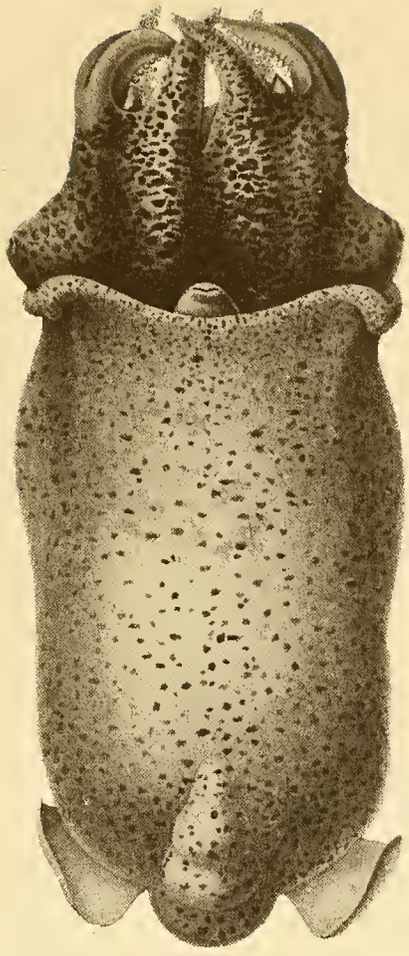
Larvae of *Spirula*

Figures 1–8. Copies of Figures 1–6 of Plate 1, and Figures 2, 3 of Plate 2, from CHUN: "Cephalopoda". *Rep. Scient. Res. "Michael Sars" North Atl. Exp.*, 1910, Vol. 3, Part 1.

1

2

7



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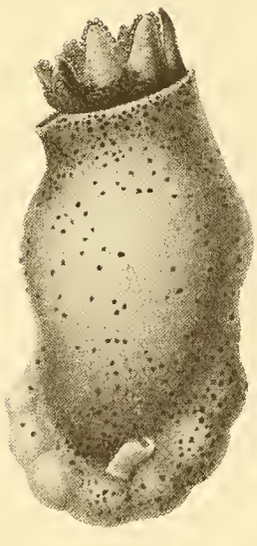


Plate LXXII

Spirula australis LAM.

Shell

Figure 1. Initial chamber and siphuncle, median longitudinal section. Zeiss 8 mm, ocular 2.
a.p' and *i.p'*—outer and inner plates of the adjacent shell wall (9th, 10th and 11th chamber); *ch* — chitinized boat-shaped lamella with remnants of epithelium; *sept*^{1} — septal neck of initial chamber, *sept*^{2}, *sept*^{3} — septal necks of 2nd and 3rd chamber; *pros* — prosiphuncle; *pil* — pillar substance; *pil'* — assumed pillar substance forming end of initial chamber; *sacc* — thickened part of shell sac, continued in the umbilicus (*umb*)

Figure 2. Initial part of shell sac occupying umbilicus (*umb*). Zeiss A 4.
v—branched capillaries; *1 . . . 8*—region of 1st–8th chambers; *umb*—connective tissue of umbilicus

Figure 3. Longitudinal section through dorsal margin of living chamber. Inner plate (*i.p.*) of shell wall detached from the epithelium

Figure 4. Opening of siphuncle into the living chamber. Zeiss A 4.
a—plug of connective tissue cells (*ep*) situated on matrix of siphonal neck; *amp.v*—ampulla-shaped dilatation of venous stems; *coel* — coelom; *h* — envelope of liver; *ep'* — torn epithelial cord providing connection with epithelium of siphuncle

ABBREVIATIONS

a — plug of connective tissue
amp — ampulla of blood vessels
a.p — outer plate
art — artery
cart — cartilage
ch — chitinous lamella
coel — coelom
cut — cutis
ek — ectoderm
ep — epithelium
h — envelope of liver
i.p — inner plate
ir — iridocytes
mu — musculature
mu.hep — muscular sheath of liver
pil — pillar
pros — prosiphuncle
sacc — shell sac
sept — septal funnel
umb — umbilicus
v — vessel

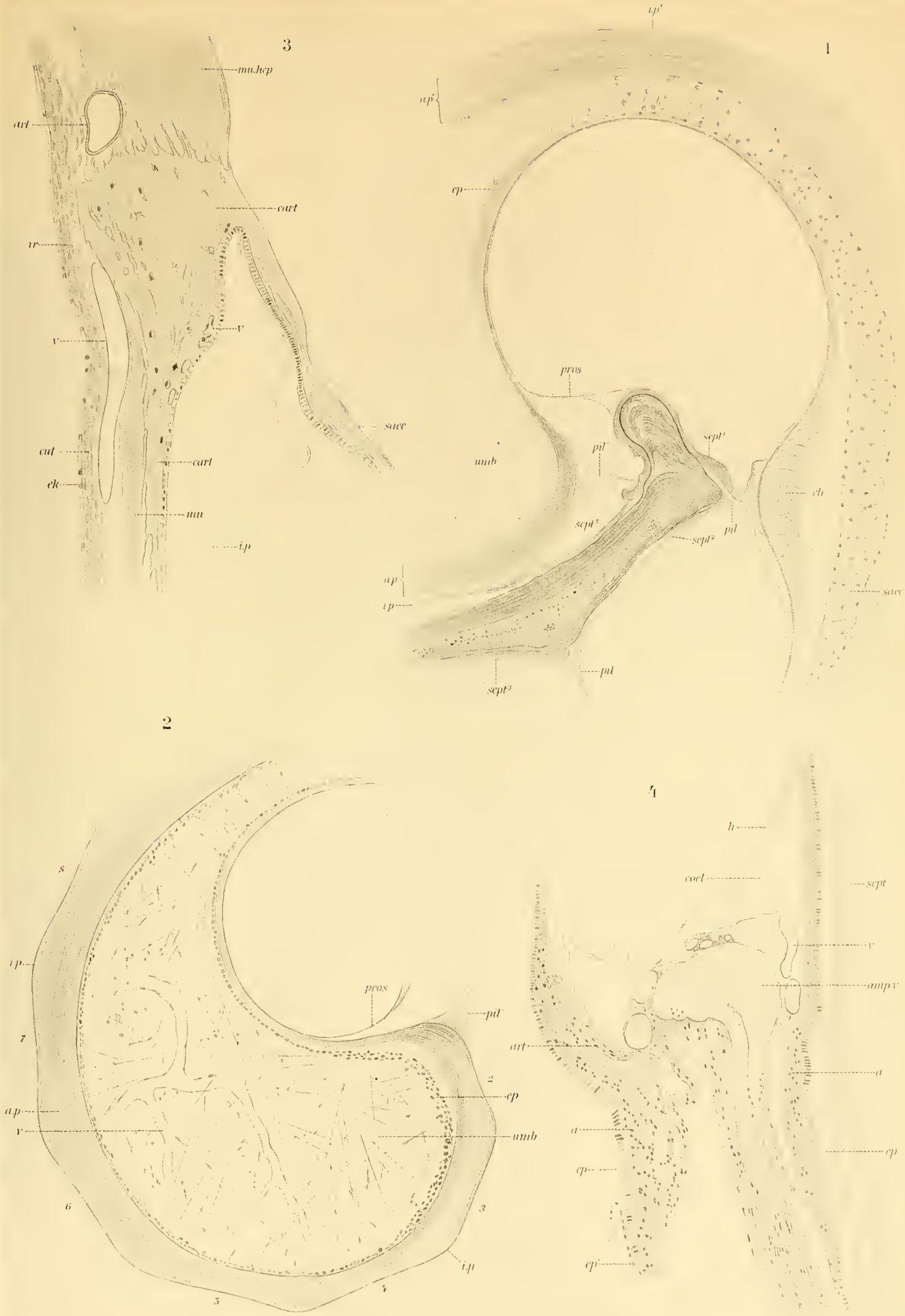

3
mu.hep
art
cart
ir
v
v
sacc
cut
cart
ek
mu
i.p
1
i.p'
a.p'
ep
pros
pil'
sept¹
umb
ch
sept²
pil
sept²
a.p
i.p
sacc
pil
sept³
2
8
i.p
pros
pil'
7
2
ep
a.p
v
umb
6
3
i.p
5
4
4
h
coel
sept
v
amp.v
art
a
a
ep
ep
ep'

Plate LXXIII

Spirula australis

Larva and Shell

Figure 1. Median section of youngest larva (Plate LXXI, Figures 1, 2). A few adjacent parts are included; stomach shown by thin line, caecum by dotted line. Shell chambers, slightly shrunk, drawn after the cleared specimen

Figure 2. Cross section of siphuncle of adult animal. Zeiss 8 mm, ocular 2

Figure 3. Part of cross section of siphuncle, with adjacent pillar and septal funnel. Zeiss, hom. immersion, 2 mm. Oc. 2

Figure 4. Nuclei of epithelium of shell sac in area of umbilicus.

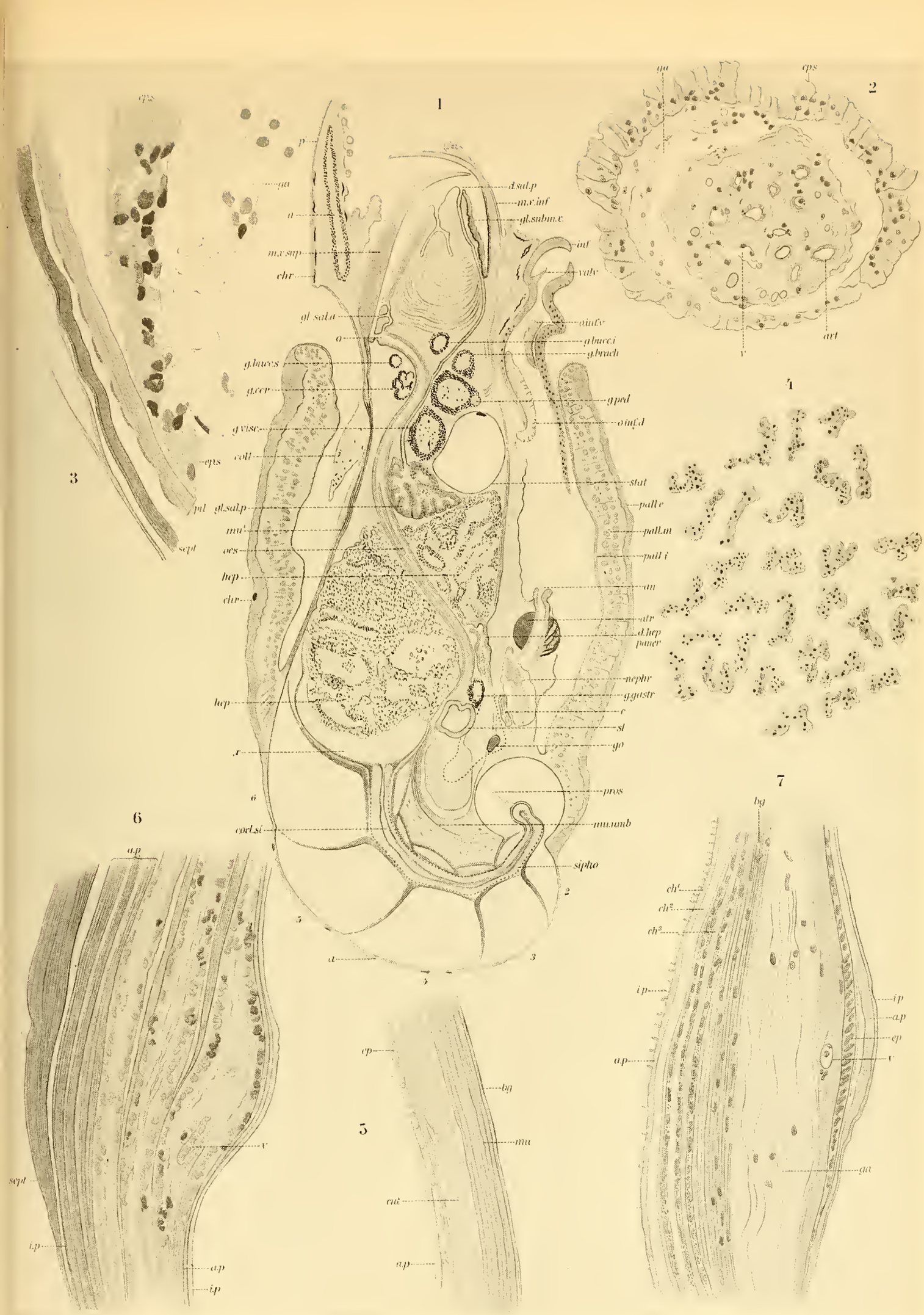
Figure 5. Longitudinal section of ventral wall of shell sac at level of the 3rd from last chamber. Zeiss 8 mm, oc. 2

Figure 6. Longitudinal section of folded shell sac in area of 4th saddle. Zeiss 8 mm, oc. 4

Figure 7. Longitudinal section of folded shell sac in area of 6th saddle. Zeiss 8 mm, oc. 4

ABBREVIATIONS

a.—thickening of larval shell sac
an — anus
a.p — outer plate
art — artery
atr — ink sac
bg — connective tissue
c — heart
ch — chitinous lamella
chr — chromatophore
coel.si — coelomic tube of siphuncle
coll — collaris
cut — cutis
d.hep.pancr — ductus hepato-pancreaticus
d.sal.p — efferent duct of posterior salivary gland
ep — epithelium
ep.s — siphonal epithelium
g.brach — ganglion brachiale
g.bucc.i — ganglion buccale inferius
g.bucc.s — ganglion buccale superius
g.cer — ganglion cerebrale
g.gastr — ganglion gastricum
g.ped — ganglion pedale
g.visc — ganglion viscerale
ga — gelatinous connective tissue
gl.sal.a — anterior salivary gland
gl.sal.p — posterior salivary gland
gl.submx — submaxillary gland
go — gonad
hep — liver
inf — funnel
i.p — inner plate
mu — musculature
mu' — musculature of body wall
mu.umb — muscle inside umbilicus
mx.inf — lower jaw
mx.sup — upper jaw
n' — nerve of dorsal arm
nephr — kidney
o — mouth
o.inf.d — dorsal funnel organ
o.inf.v — ventral funnel organ
oes — esophagus
p' — dorsal arm
pall.e — outer layer of mantle
pall.i — inner layer of mantle
pall.m — middle layer of mantle
pil — pillar
pros — prosiphuncle
sept — septal funnel
st — stomach
stat — static organ
v — vessel
valv — funnel valve
x — space enlarged by detachment of liver
2,3,4,5,6 — 2nd to 6th chambers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2
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4
5
6
7
eps
ga
p
a
m.x.sup
chr
d.sal.p
m.x.inf
gl.subm.x.
inf
valv
gl.sal.a
o
o.inf.v
g.bucc.i
g.brach
g.bucc.s
g.cer
g.ped
g.visc.
o.inf.d
coll
stat
pil
gl.sal.p
pall.e
mu'
pall.m
oes
pall.i
hep
an
chr
atr
d.hep
pancr
nephr
g.gastr
hep
c
sl
go
x
pros
coel.si
mu.umb
sipho
a
art
v
bg
ch'
ch²
ch³
i.p
a.p
ep
ga
sept
i.p
a.p
i.p
ep
bg
mu
cut
a.p

Plate LXXIV

Argonauta

Figure 1. *Argonauta hians* SOLANDER, male: Station 50, South Equatorial Current. × 6
Figure 2. *Argonauta hians* SOLANDER, female: Station 50, South Equatorial Current. × 6
Figure 3. *Argonauta* sp., juvenile female: Station 263. Indian North Equatorial Current. × 6
Figure 4. *Argonauta hians*, male; Station 50. Funnel and mantle cartilage. Appr. × 20
Figure 5. *Argonauta hians*, male: Station 50. Arm apparatus. Appr. × 12
Figure 6. *Argonauta hians*, female: Station 50. Funnel and mantle cartilages

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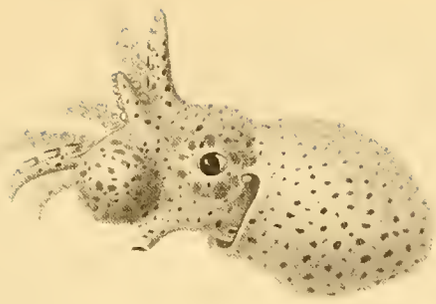

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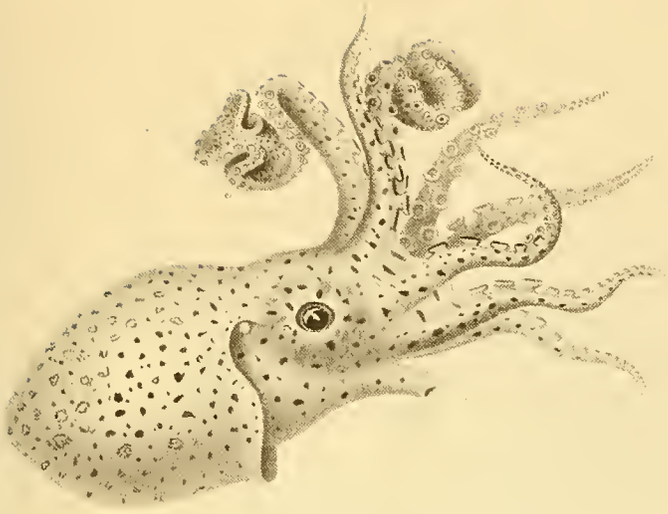

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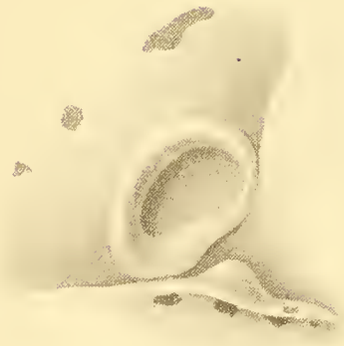

Plate LXXV

Velodona togata n. gen., n. sp.

Right side. Natural size. Drawn from color sketch of the live animal. Station 249. Trawl, 749 m. Near the Somali coast

Plate LXXVI

Velodona togata n. gen., n. sp.

Dorsal view. Drawn from color sketch of the live animal. Station 249. Trawl, 749 m. Near the Somali coast

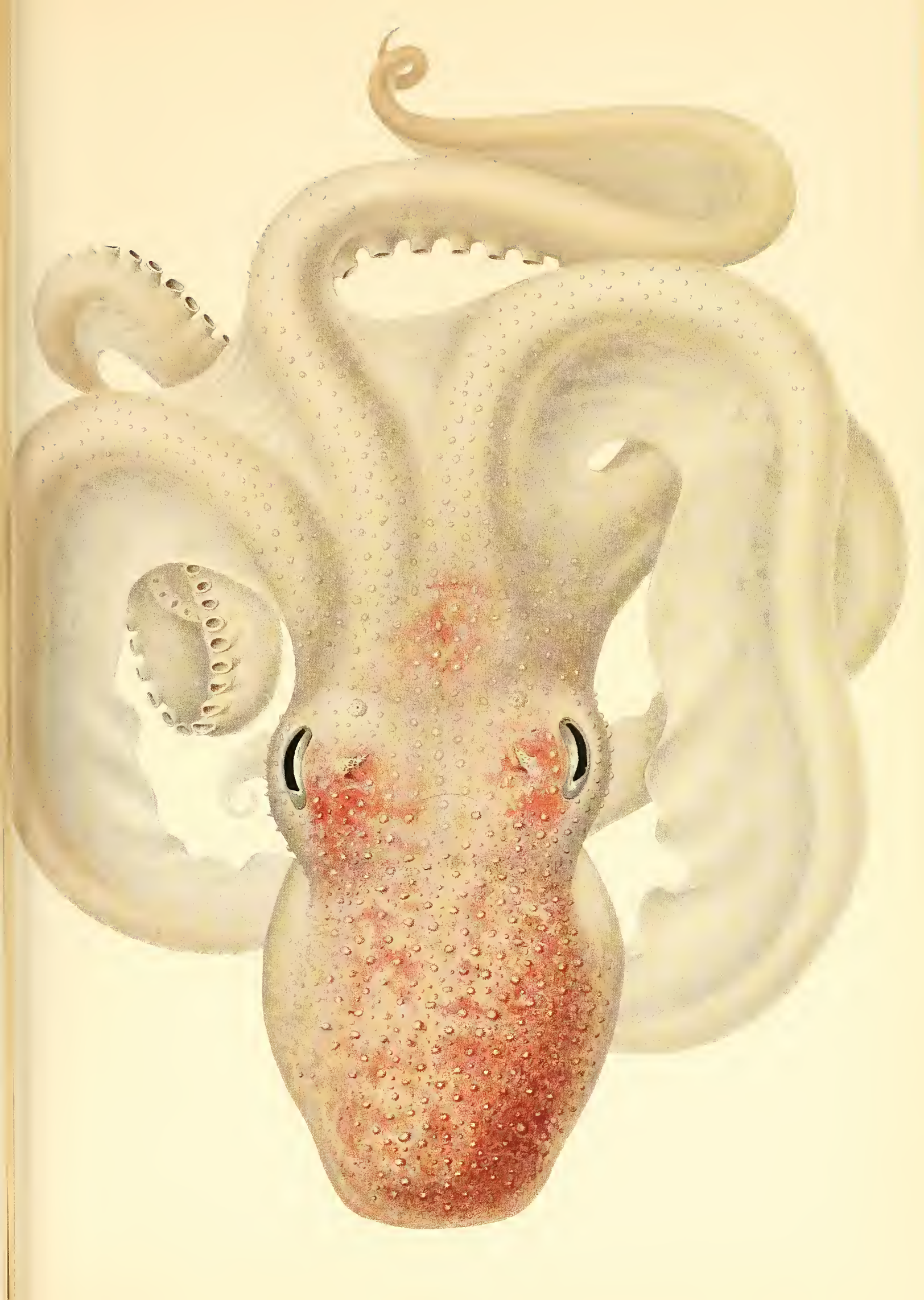

Plate LXXVII

Tremoctopus hyalinus RANG, juv. (Figures 1, 4, 5, 6); *Polypus* juv. (Figures 2, 3, 7).

Figure 1. *Tremoctopus hyalinus* RANG, juv., Station 49, South Equatorial Current. × 6
Figure 2. *Polypus* juv., Station 244, Zanzibar Canal. × 6
Figure 3. *Polypus* (*brevipes* D'ORB.?) juv., Station 207, Indian North Equatorial Current, Surat Passage. × 6
Figure 4. Thickened right margin of mantle of *Tremoctopus*, Station 49.
Figure 5. Funnel, mantle margin and anus of *Tremoctopus*, Station 49. Appr. × 18
Figure 6. *Tremoctopus hyalinus* juv., Station 49. Arm apparatus. × 12
Figure 7. *Polypus* juv., Station 244. Arm apparatus. × 12

2

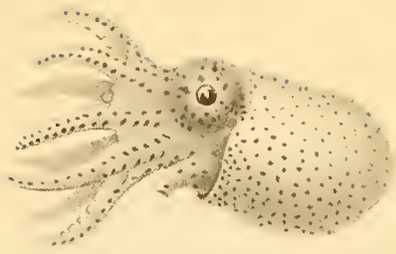

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Plate LXXVIII

Larvae of Bristle Bearing Octopoda

Figure 1. Larva of Octopoda with bristles, Station 223, Indian Countercurrent. × 6
Figure 2. Larva of Octopoda with bristles, Station 41, Guinea Current. × 6
Figure 3. Same larva, higher magnification, × 30
Figure 4. Arm apparatus of larva from Station 223. Appr. × 12
Figure 5. Arm apparatus of larva from Station 41. × 12.

1

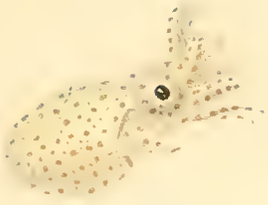

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Plate LXXIX

Polypus levis HOYLE, male

Station 160, Port Gazelle, Kerguelen.

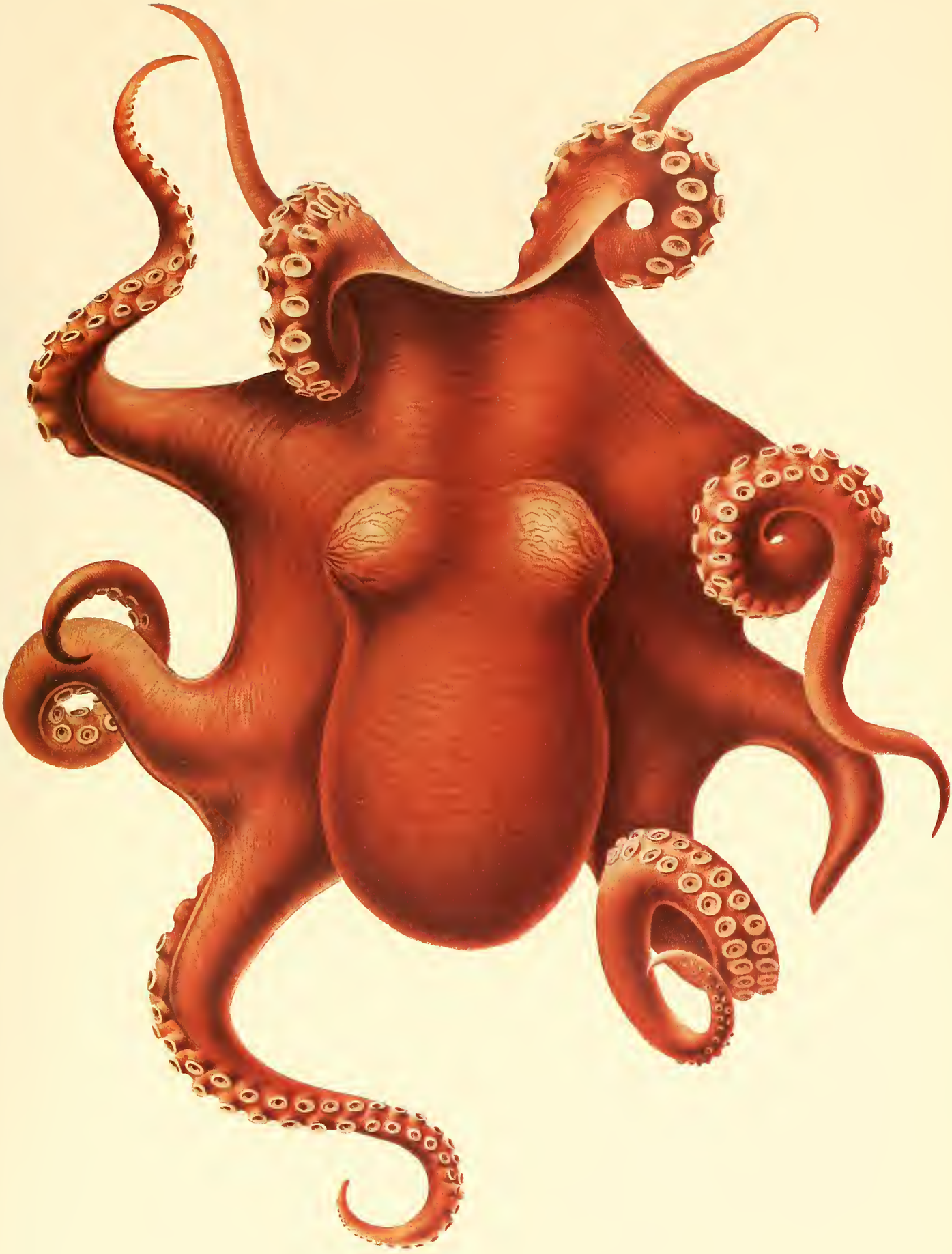


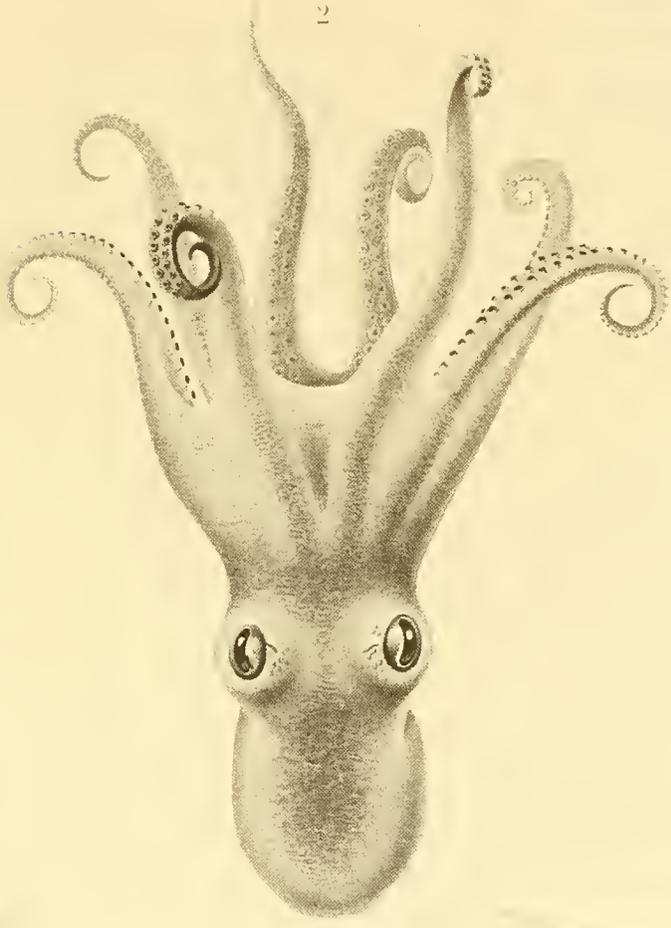
Plate LXXX

Polypus valdiviae. Station 103, Agulhas Bank

Figure 4. Hectocotylus.
Figure 5. Young male?

1

2



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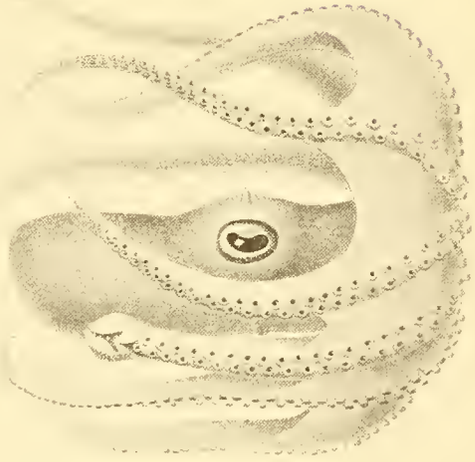

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Plate LXXXI

Eledonella pygmaea VERR.

Figures 1–2. Young females.
Figure 3. Male, probably from the material of the *Michael Sars* Expedition.
Figure 4. Hectocotylus of younger male.
Figure 5. Female. Station 53. Gulf of Guinea

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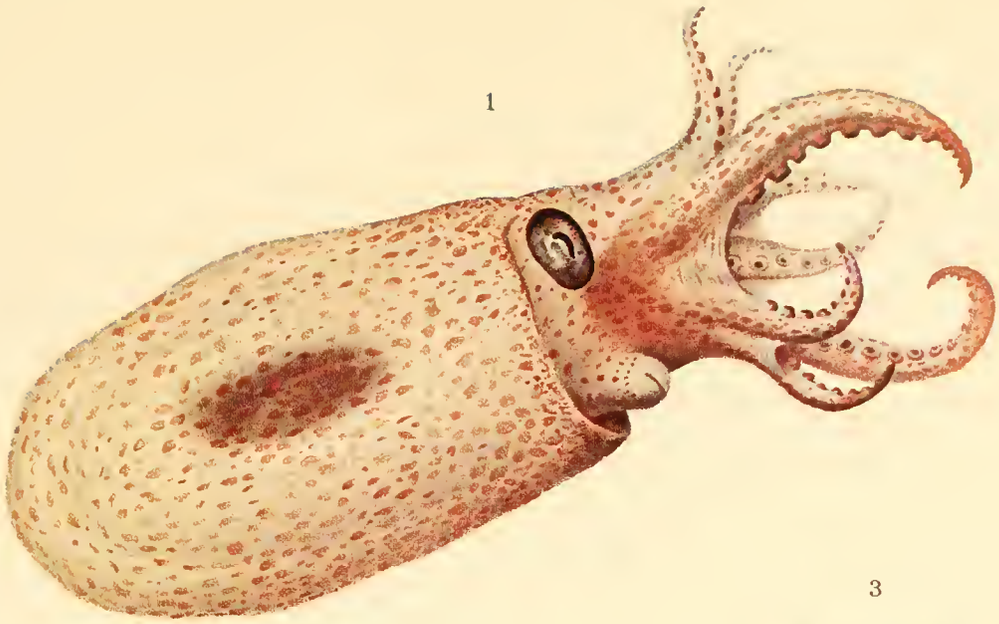
Plate LXXXII

Bolitaena diaphana STEENSTR.

Figures 1 and 4. Station 66b, northeast of S. Thomé.
Figures 2 and 3. Station 50, Gulf of Guinea.

1



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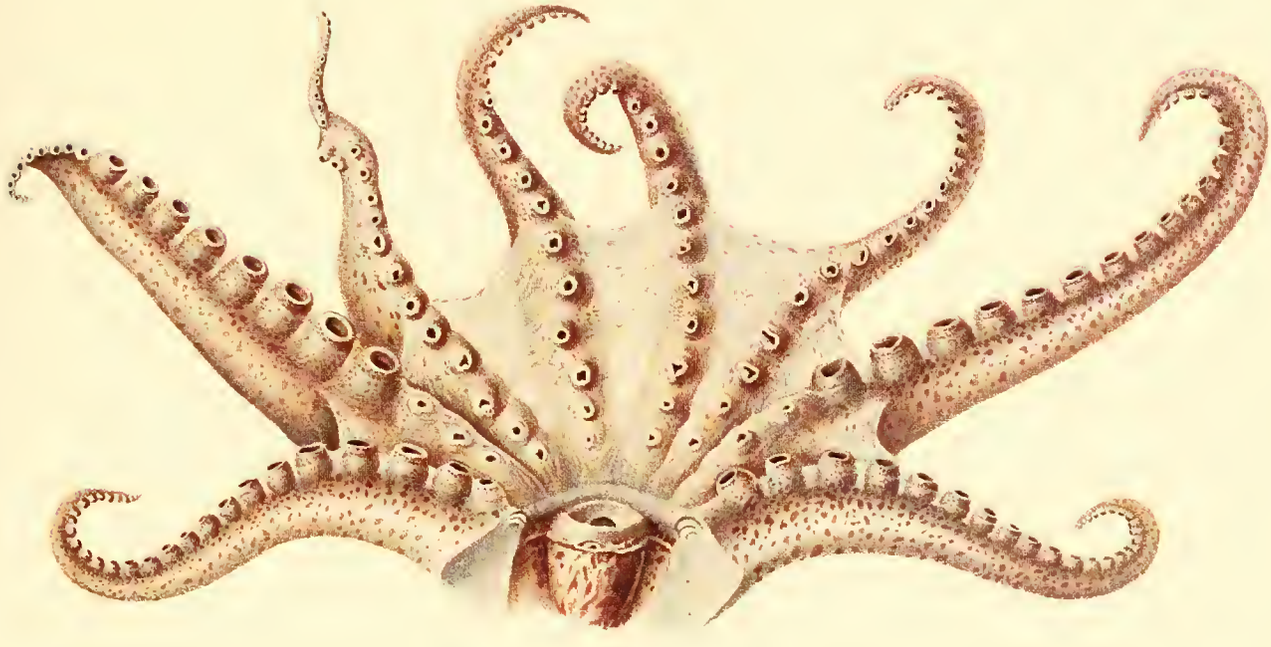

Plate LXXXIII

Bolitaena diaphana STEENSTR., juv.

Figure 1. Station 190, near Sumatra.
Figures 2 and 6. Station 217, southwest of Ceylon.
Figures 3, 4, 5, 7, 8. Station 44, south of Sierra Leone.
Figures 9 and 10. Station 66b, northeast of S. Thomé.

ABBREVIATIONS

c. branch. — branchial heart
g. stell. — ganglion stellatum
sept. — mantle septum

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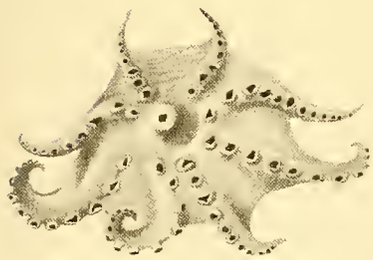

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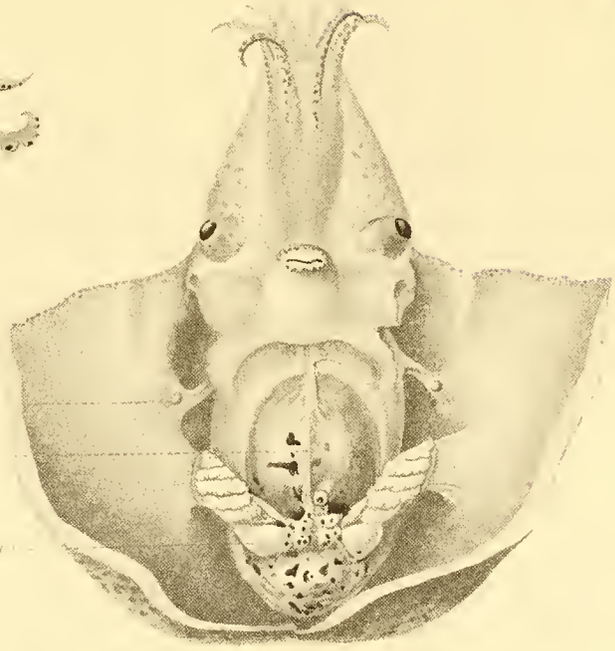

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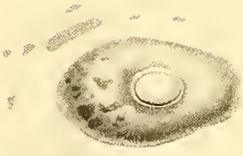

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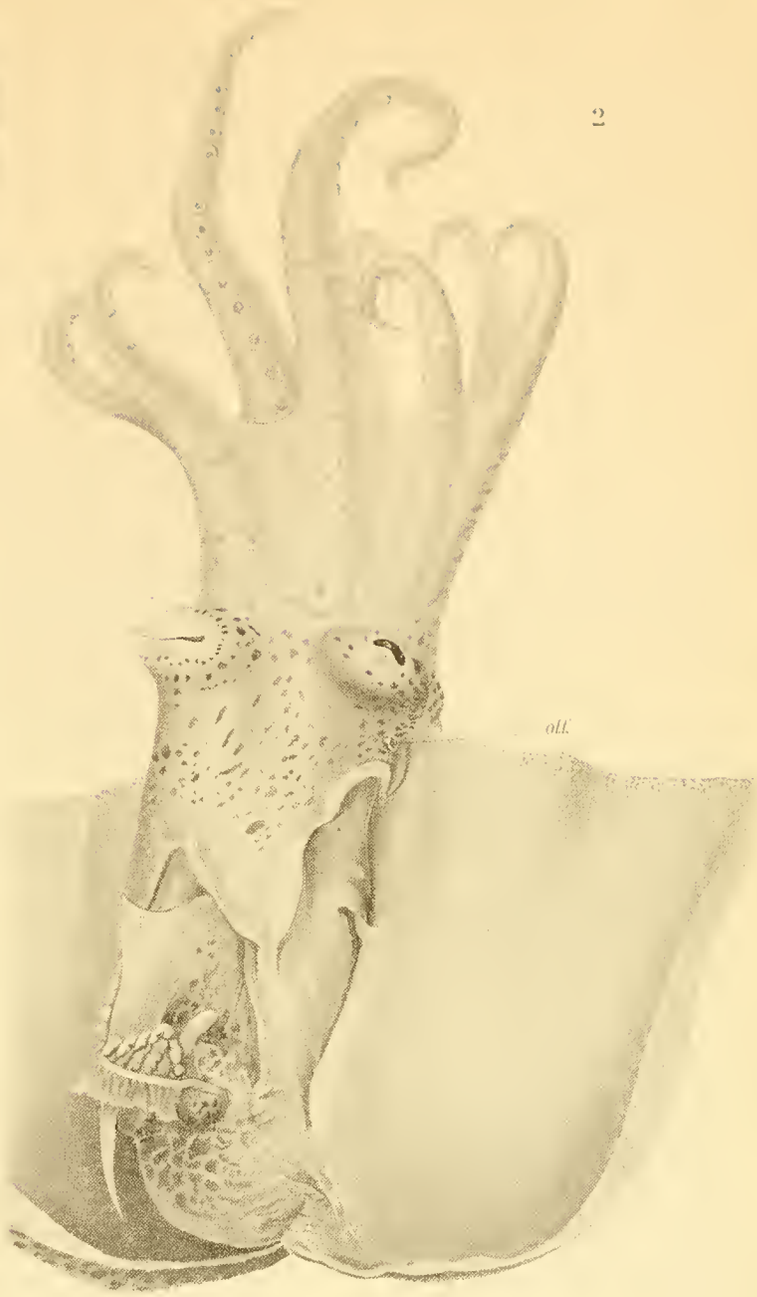
Plate LXXXIV

Figure 1. *Bolitaena*, ventral view, with opened gelatinous mantle. Mantle septum, strongly pigmented visceral sac and right gill visible. The larger arm (3rd right arm), which faces the observer, is hectocotylized

ABBREVIATIONS

c. branch. — branchial heart
org. infund. — funnel organ
pen. — penis
sept. — mantle septum
test. — testis

1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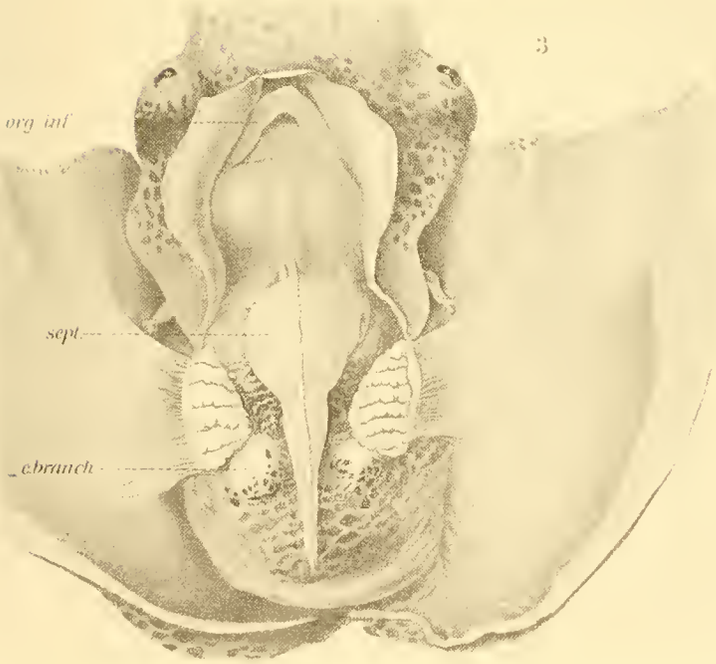
olf.


3
org inf
sept.
e.branch

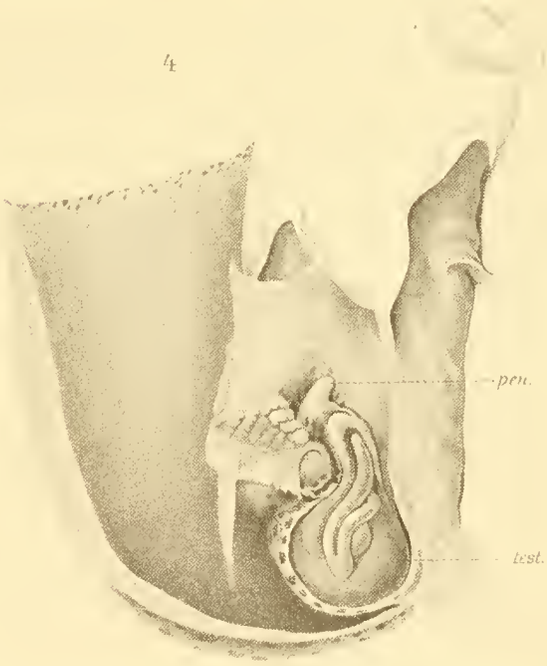

4
pen.
test.

Plate LXXXV

Bolitaena, *Eledonella*; Nervous System

Figures 1–5. *Bolitaena diaphana* STEENSTR. Station 50

Figure 1. Central nervous system with adjacent organs of medium-sized specimen. Dorsal view
Figure 2. Central nervous system of same specimen, ventral view.
Figure 3. Central nervous system and nerves of arms of same specimen. Ventral view. Arms obliquely cut open, to show transverse lamellae in the gelatinous substance and nerves shining through
Figure 4. Ganglia of visceral nerves at level of anus.
Figure 5. Infraesophageal ganglion.
Figure 6. *Bolitaena*, Station 66. Gastric ganglion

Figures 7, 8. *Eledonella pygmaea*. Experimental Station 53

Figure 7. Central nervous system, ventral view. × 20
Figure 8. Central nervous system, dorsal view. × 20

ABBREVIATIONS

a. brach — arteria brachialis
a. bucc — arteria buccalis
a. ceph — arteria cephalica
a. inf—arteria infundibuli
an — anus
a. ophth — arteria ophthalmica
a. saliv — artery to salivary glands
a. stat — artery to static organ
c. alb — white body
c. brach. b—commissura brachio-buccalis
c. b. s. i—commissura supraoesophagea-infraoesophagea
com. brach—commissura brachialis
d. saliv. p—efferent duct of posterior salivary gland
g^1—ganglionic swelling of the optic nerve
g. brach — ganglion brachiale
g. bucc. i — ganglion buccale inferius
g. bucc. s — ganglion buccale superius
g. cer — ganglion cerebrale
g. gast — ganglion gastricum
g. n. o. i—ganglion nervi ophthalmii inferior
g. n. visc — ganglion nervi visceralis
g. opt — ganglion opticum
g. ped — ganglion pedale
g. pedunc — ganglion pedunculi
g. visc — ganglion viscerale
g. saliv. a — anterior salivary gland
n. abd — nervus abdominalis
n. acc. olf—nervus accessorius olfactorii
n. add. inf—nervus adductor infudibuli
n. ant — nervus anterior
n. a. o. s — nervus antorbitalis superior
n. brach — nervus brachialis
n. inf. a — nervus infundibuli anterior
n. inf. p. — nervus infundibuli posterior
n. lab — nervus labialis
n. oc. i—nervus oculomotorius inferior
n. olf — nervus olfactorius
n. opt. — nervus opticus
n. ophth. a—nervus ophthalmicus anterior
n. ophth. i—nervus ophthalmicus inferior
n. ophth. p—nervus ophthalmicus posterior
n. pall — nervus pallialis
n. symp — nervus sympaticus
n. visc — nervus visceralis
oes — esophagus
opt — optic nerve
rect — rectum
stat — nervus staticus
v. c — vena cava

Plate LXXXVI

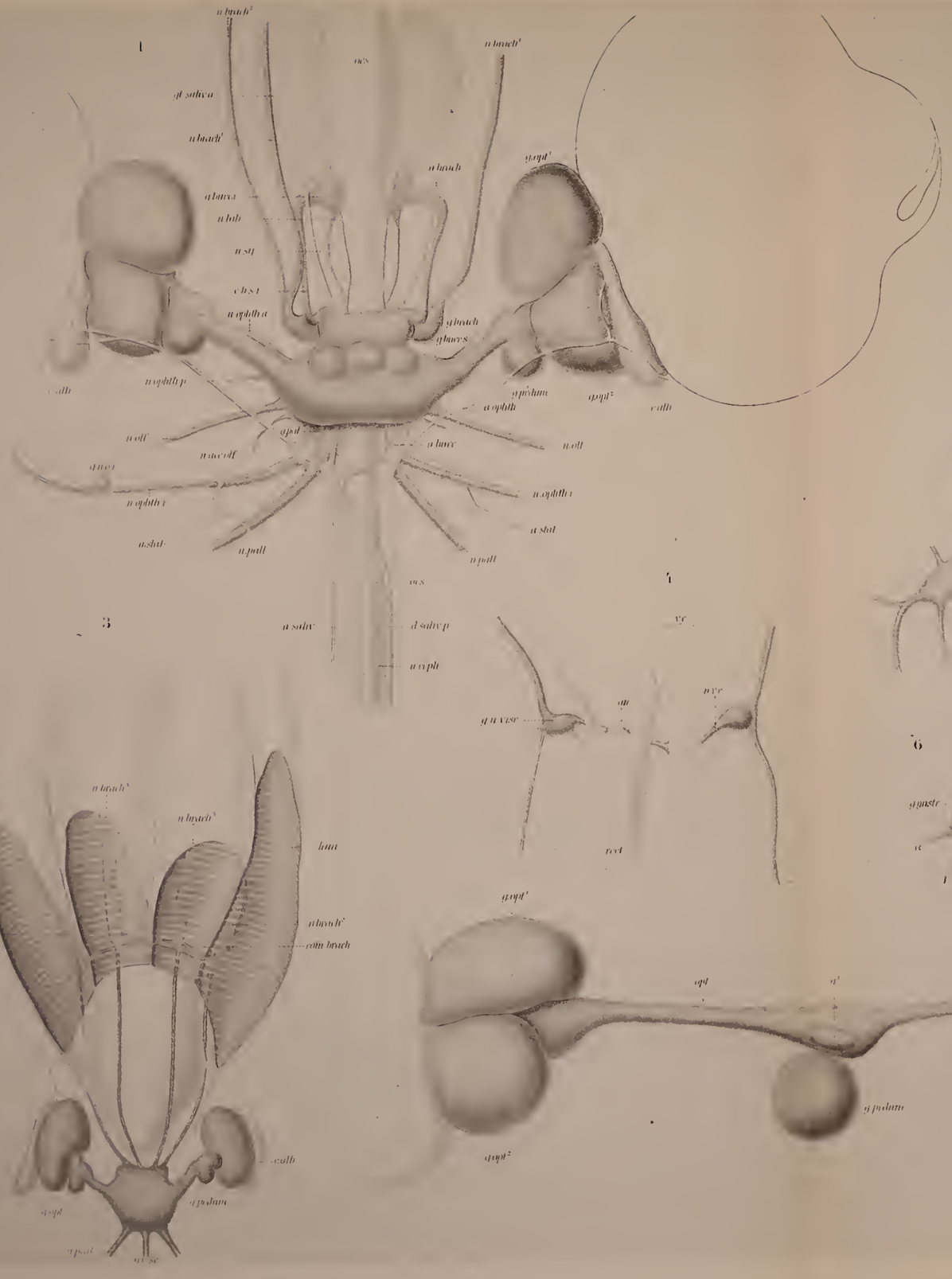
Bolitaena, *Eledonella*

Figures 1–8, Static Organs; Figure 9, Osphradium

Figure 1. *Bolitaena*. Station 50. Static organ, dorsal view
Figure 2. *Eledonella*. Macula statica princeps with statoliths, seen from above
Figure 3. Same, lateral view.
Figure 4. *Bolitaena*. Station 50. Ciliated canal with adjacent parts; *a*—nonciliated distal part
Figure 5. *Eledonella*. Station 49. Right static organ with brain and cerebral nerves showing through, ventral view
Figure 6. *Bolitaena*. Station 50. Both static organs with their capsules, ventral view. Arms of vena cava and adjacent nerves indicated
Figure 7. *Bolitaena*. Terminal branching of 3rd static nerve
Figure 8. *Bolitaena*. Nuclei of the inner wall of static organ and capillaries
Figure 9. Osphradium (tuberculum olfactorium) of *Bolitaena*. Station 66. *a*—lateral view, *b*—seen from above

ABBREVIATIONS

can. cil — ciliated canal
a — distal end of ciliated canal
cap — capillary vessels
caps — capsules of static organs
c. v. br.—arms of vena cava (circulus venous brachialis)
cr. st — crista statica
g. opt — ganglion opticum
g. ped — ganglion pedunculi
mac. st—sensory pad (macula statica princeps)
n. abd — nervus abdominalis
n. inf. a — nervus infundibuli anterior
n. inf. p — nervus infundibuli posterior
n. olf—nervus olfactorius, sensory branch
n. olf^1, *n. olf*^{2}—nervus olfactorius, motor branches
n. ophth. a—nervus ophthalmicus anterior
n. ophth. i—nervus ophthalmicus inferior
n. opt — nervus opticus
n. pall — nervus pallialis
n. stat^1—nervus staticus, branch to macula princeps
n. stat^2—nervus staticus, branch to distal part of crista
n. stat^3—nervus staticus, branch to proximal part of crista
n. v. c — nerve of vena cava
n. visc — nervus visceralis
nu — nuclei
p — pore of ciliated canal
stat — statolith
v. inf — funnel vein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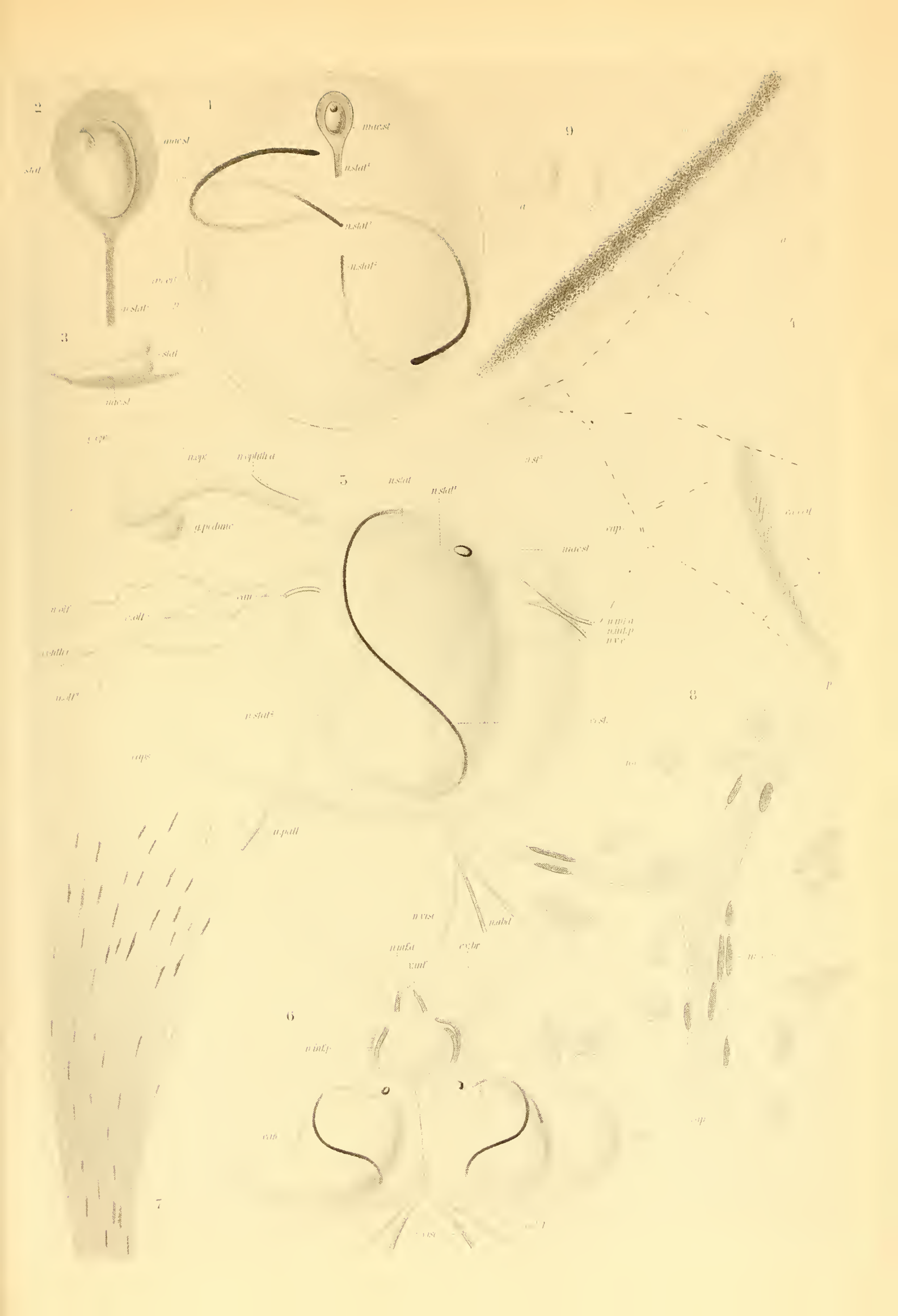

Plate LXXXVII

Bolitaena

Figures 1–3, Intestinal Tract; Figures 4–9, Male Genitalia

Figure 1. *Bolitaena diaphana*. Station 50. Intestinal tract, right side: pharynx and brain, dorsal view. × 5

Figure 2. Same, ventral view. × 5

Figure 3. Same, diagonally from the dorsal view, with layer of neighboring chromatophores. *a*—sickle-shaped muscular pad; *b*—connecting cord; *c*—lateral pad; *d*—terminal dome

Figure 4–9. Male genitalia of *Bolitaena diaphana*. Stations 66 and 50

Figure 4. Testis, gonoducts and adjacent organs in situ. Station 50. Younger specimen

Figure 5. Gonoducts of older specimen from Station 66 (spread).

Figure 6. Same, natural position, viewed from the outside (cf. Plate LXXXIV, Figure 4).

Figure 7. Initial part of gonoducts viewed from the inside.

Figure 8. Penis with diverticulum in optical longitudinal section. × 7

Figure 9. Aciniform gland of appendix.

ABBREVIATIONS

amp — ampulla
an — anus
app — appendix
app. an — anal appendages
atr — ink sac
b. sperm — spermatophore sac
branch — gill
c. alb — white body
c. branch — branchial heart
caps — capsule of testis
cer — cerebral ganglion
coll. p — cervix of penis
coec — evagination of appendix
d. hep. pancr — ductus hepato-pancreaticus
d. sal — salivary duct
div. pen — diverticulum of penis
g. gastr — ganglion gastricum
g. opt — ganglion opticum
g. ped — ganglion pedale
gl — gland
gl. ac — aciniform gland
gl. sal. a — anterior salivary gland
gl. sal. p — posterior salivary gland
hep — liver
ingl — crop
int — intestine
n. pall — pallial nerve
oes — esophagus
pancr — pancreas
pen — penis
ph — pharynx
prost — prostate
prost^1 — end of prostate
rect — rectum
st — stomach
st. coec — caecum
test — testis
v. def — vas deferens
v. eff — vas efferens
ves. sem^1, *ves. sem*^{2}, *ves. sem*^{3} — 1st, 2nd and 3rd part of vesicula seminalis

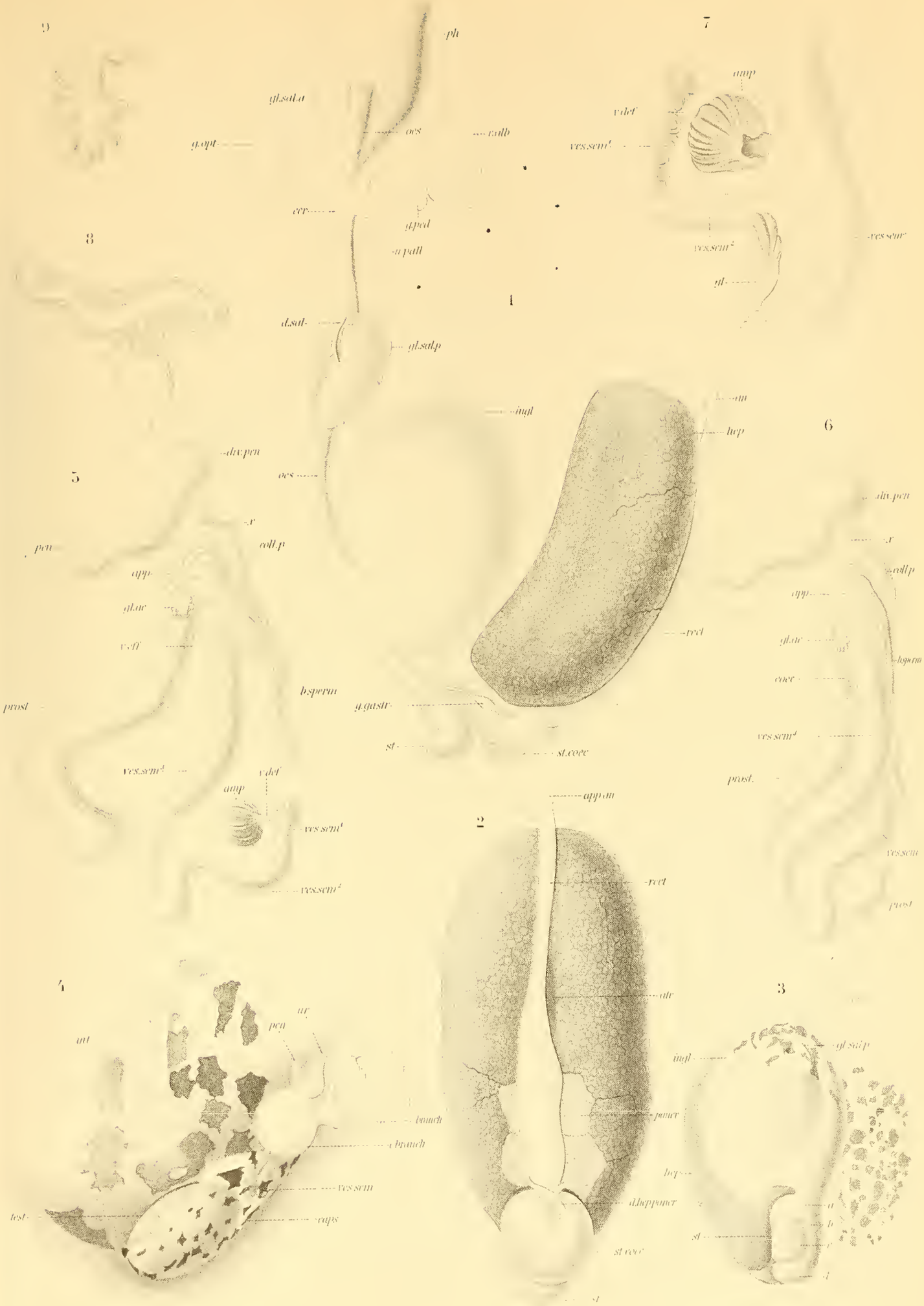
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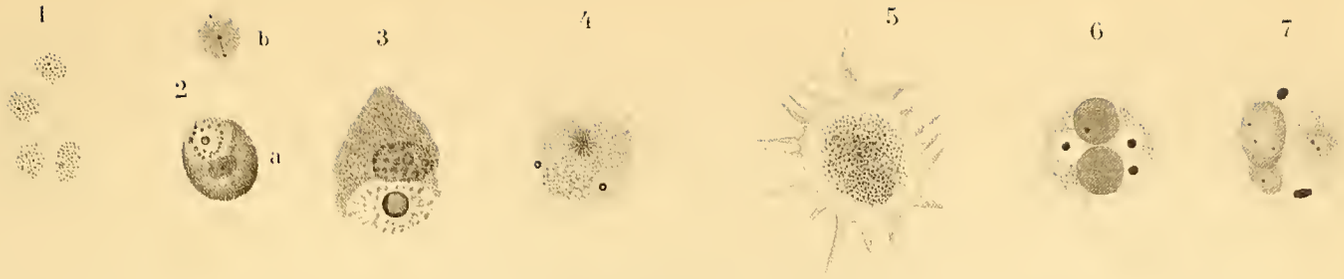
Plate LXXXVIII

Bolitaena. Development of Chromatophores

Preparations made from mantle of two young specimens fixed with chrome-osmium acid (Fleming's solution). The specimens are 25 mm (Station 190) and 24 mm (Station 232) long and have a mantle length of 16 and 14 mm, respectively. Dye: iron hematoxylin, Heidenhain method. One specimen (Station 190) illustrated on Plate LXXXVIII, Figure 1.

Drawings with Zeiss Apochromat homogeneous immersion 1/12 and oculars 0, 2, 4. Muscle processes stained blue, nerves brownish.

Figure 1. Nest of connective tissue cells from the gelatinous substance.
Figure 2a. Youngest stage of the chromatophore, with sphere.
Figure 2b. Sphere with central granule and radial fibers.
Figure 3. Cell with coarsely granulate nucleus and light-colored secretory vacuole that contains a spherical mass of secretion.
Figure 4. Young mononuclear chromatophore with sphere and radial pseudopodium-like processes.
Figure 5. Slightly older stage with light-colored ectoplasm that has radial processes.
Figure 6. Binuclear cell with short processes.
Figure 7. Binuclear cell with sphere and two secretory masses, without processes.
Figure 8. Young binuclear chromatophore with radial muscular processes of which 3 are innervated.
Figure 9. Young chromatophore with 4 nuclei, two of which are homogeneous, and the other two finely granulated. The ring-shaped arrangement of the contractile substance between the processes is distinct
Figure 10. Young chromatophore with 5 nuclei, lateral view. The outward-facing hood-like dome is filled with flakes of secretion
Figure 11. Chromatophore with 5 nuclei and its nervous network.
Figure 12. Chromatophore with 8 deeply situated nuclei which are covered by the hood-shaped dome. Mononuclear youngest stage shown situated nearby
Figure 13. Chromatophore with 16 nuclei which are still situated centrally.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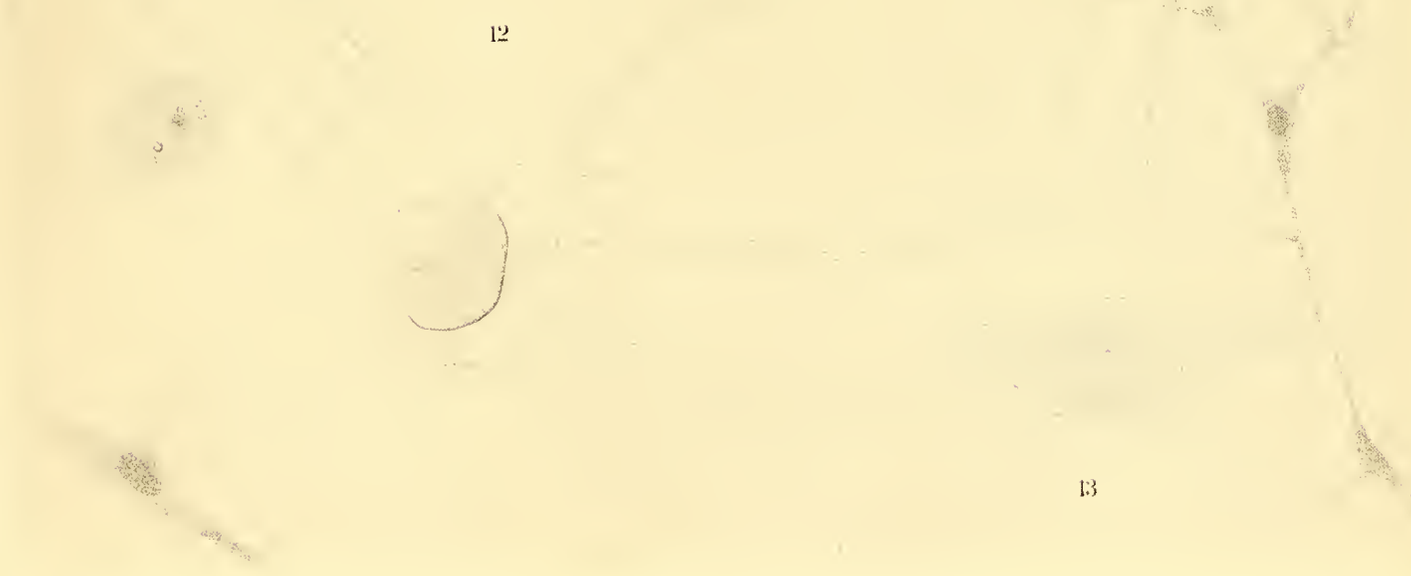
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Plate LXXXIX

Bolitaena diaphana

Chromatophores, Musculature, Nervous Network, and Structure of Bristle Tufts

Preparations of mantle of two specimens (Stations 190 and 232) fixed with chrome-osmium acid. Musculature stained bluish, nervous network brownish. Dye: iron hematoxylin. Heidenhain method.

n — nerve *nu* — nucleus *v* — vessel

Figure 1. Surface preparation showing the deeply situated branched musculature, the network of nerve endings and two contracted, developed chromatophores; also visible are two young stages of chromatophores. Network of nerve endings examined with homogeneous immersion 1/12. × 165

Figure 2. Branched musculature and contracted chromatophores from ventral margin of mantle. × 100

Figure 3. Expanded chromatophores with nervous network and branched musculature. Main nucleus of chromatophore, surrounded by a halo in center of large vacuole (situated on stem of longitudinal muscles). × 100

Figure 4 a, b, c. Base of the muscular processes of developed chromatophores.

Figure 5. Young chromatophore with a central main nucleus surrounded by a honeycomb-like plasma and with peripheral nuclei displaced to the base of the muscular processes. Specimen from Station 65; fixation with sublimate and acid carmine. Homogeneous immersion 1/12

Figure 6. Young chromatophore after staining with osmium (Station 190). The cap-shaped apex (Plate LXXXVIII, Figure 10) has become flattened and has filled with light-brown pigment granules. The main nucleus is stained black by osmium; the other nuclei have moved to the base of the muscular processes

Figure 7. Division site of a nerve, with two granulate nerve nuclei and a homogeneous sheath nucleus.

Figure 8. Division site of a nerve with two homogeneous nuclei and one granulate nerve nucleus.

Figure 9. Ventral surface of specimen from Station 190, showing osmium-stained superficial longitudinal and transverse muscle fibers; chromatophores situated mainly along muscle fibers. The upper margin corresponds to the mantle margin at the level of the funnel. × 8

Figures 10–13. Development and structure of bristle tufts (specimen from Station 232). Hom. immersion 1/12

Figure 10. Ectodermal cell plug with finely striated cone and basal cell situated below it.

Figure 11. Developed tuft of bristles. Two smaller nuclei are seen persisting near the large basal nucleus

Figure 12. Tuft of bristles seen from above, with basal nucleus and peripheral muscular processes.

Figure 13. Chitinous cup with thin bristle tuft.

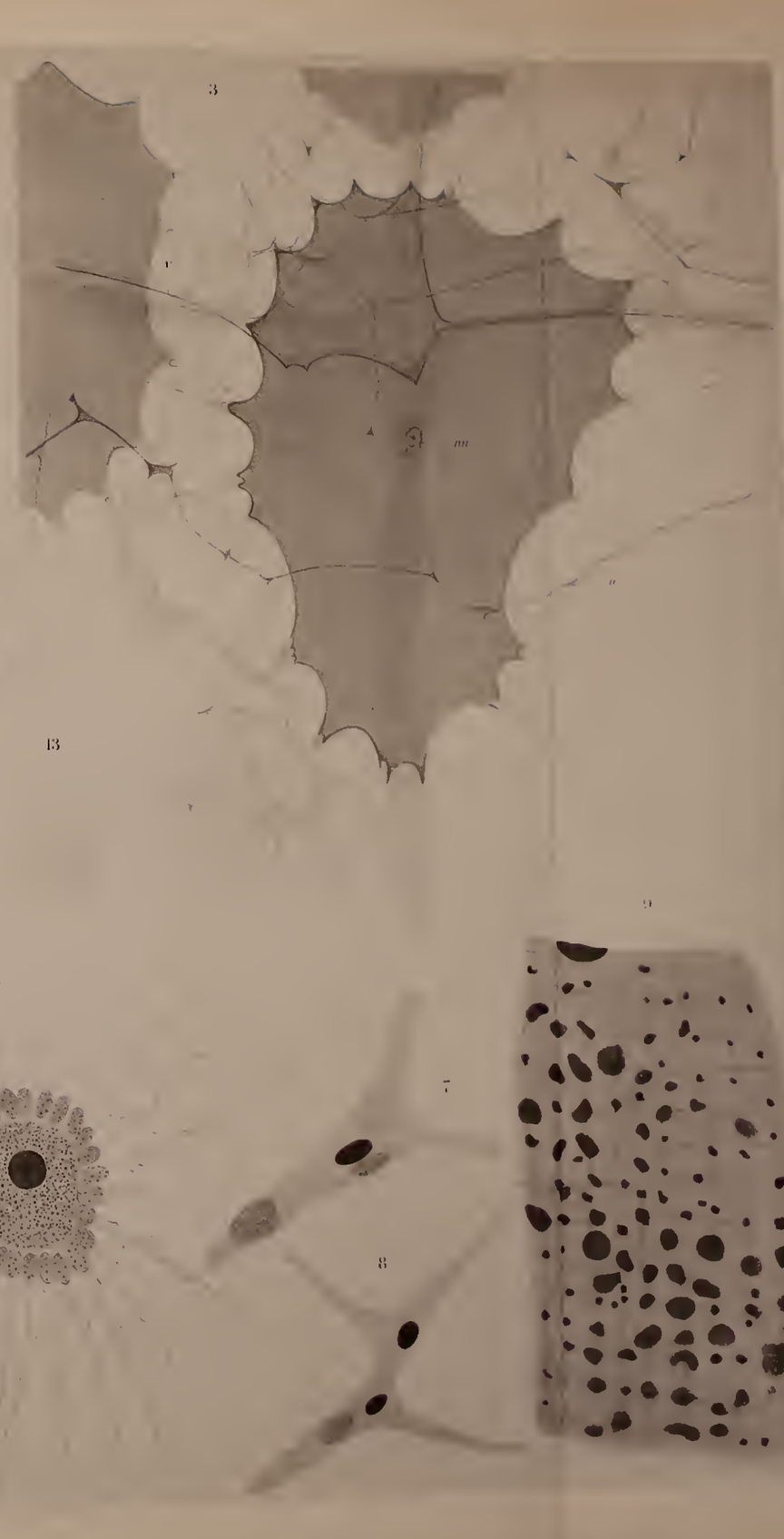
Plate XC

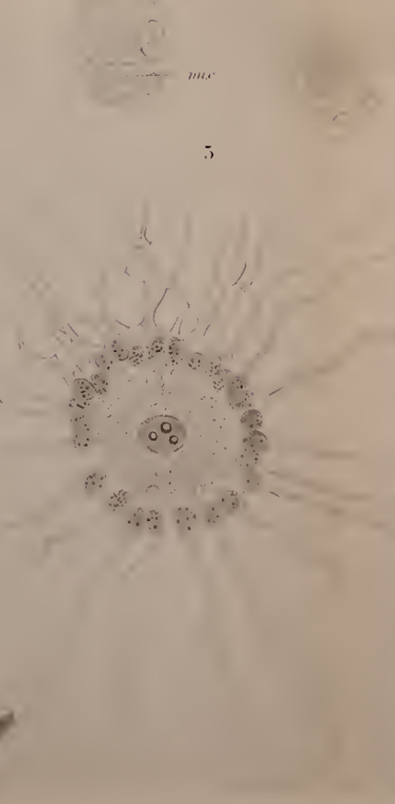
Vampyroteuthis infernalis n. gen., n. sp.

Specimen from Station 65 (Latitude of Cape Verde)

Vertical Net to 1,200 m

Figure 1. Right side. × 3.5
Figure 2. Dorsal view. × 3.5
Figure 3. Arms with umbrella. × 4.5





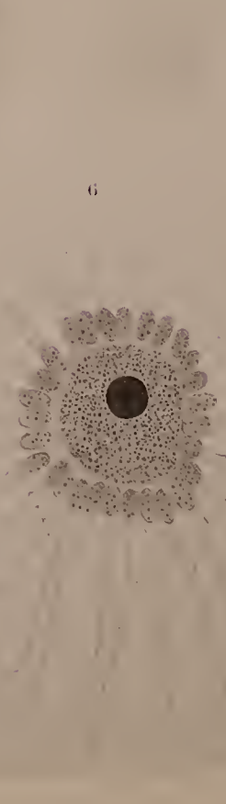


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Plate XCI

Vampyroteuthis, Amphitretus

Figures 1–5. *Vampyroteuthis infernalis* n.g. and sp.

Figure 1. Specimen from Station 65. Ventral view of mantle complex. × 3.5. Notable are the blackish stained rectum, the renal papillae, the branchial hearts (*c. branch.*), and the gonad (*go.*) which is light-colored and shines through above the stomach

Figure 2. Youngest specimen, ventral view, with spread umbrella.

Figure 3. Young specimen from Station 85 (Benguela Current), left side. Muscular bands of mantle gaping open on dorsal side. × 3

Figure 4. Left eye of specimen from Station 65. Eye protruding from lid fold. × 4.5

tub. olf. — olfactory tubercle *c. alb.* — white body

Figure 5. Right eye of same specimen. Eye covered by lid fold. Brownish iris visible through pupil. × 4.5

Figures 6–10. *Amphitretus pelagicus* HOYLE

Figure 6. *Amphitretus pelagicus* HOYLE, left side. Station 102, Agulhas Current. Vertical net to 1,800 m. × 2. Specimen is damaged: gelatinous skin and funnel chafed off

Figure 7. Eyes, dorsal view. Color sketch from the live animal

Figure 8. Right eye, lateral view.

Figure 9. Median section through right eye (in direction of cross section of whole animal).

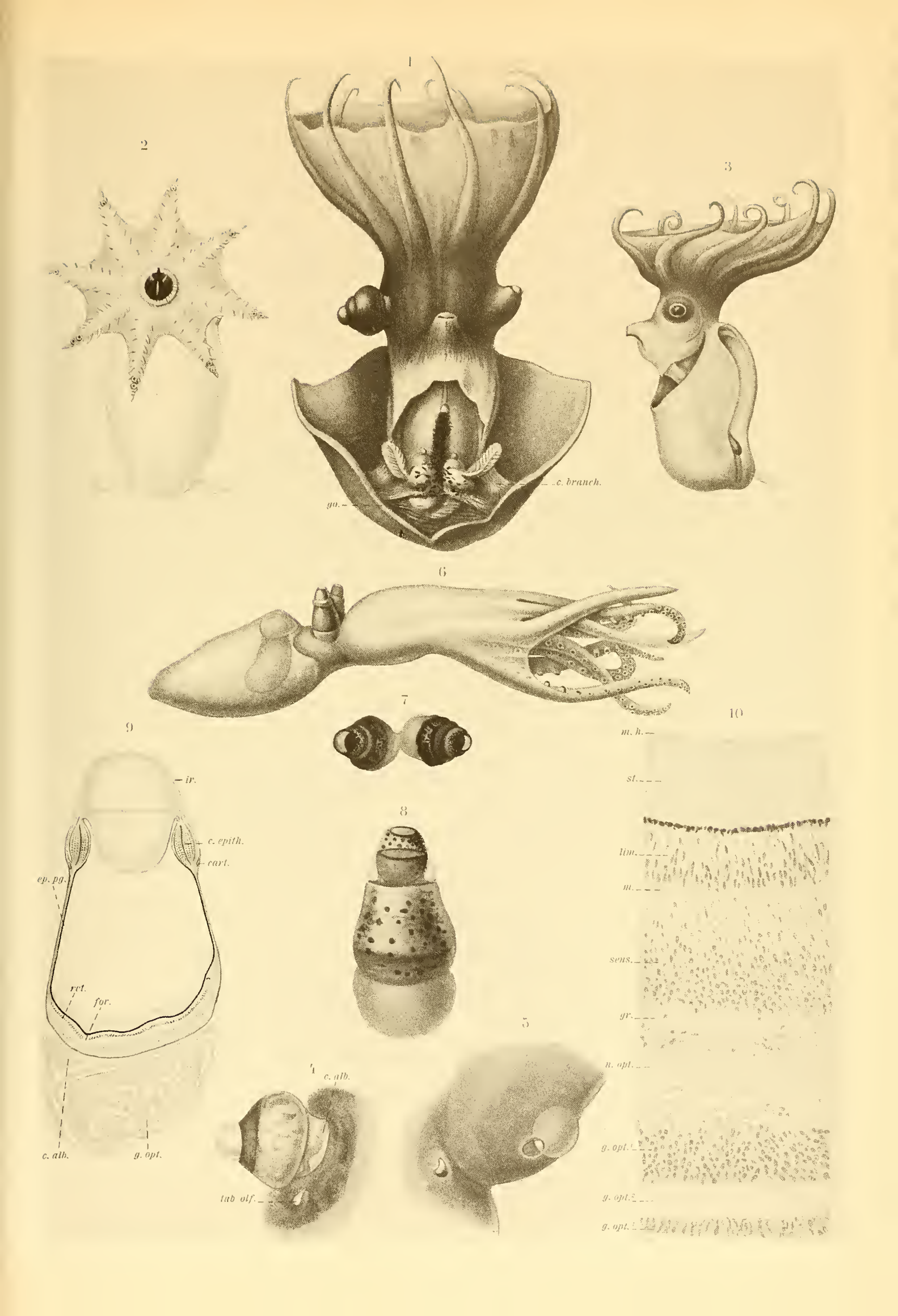
ABBREVIATIONS

c. alb. — white body
cart.—cartilaginous ring at root of iris and epithelial body
c. epith. — epithelial (ciliary) body
ep. pg. — pigmented epithelium
fov. — pitlike depression of retina on outer side of eyeball
g. opt. — optic ganglion
ir. — iris
ret. — retina

Figure 10. Retina of *Amphitretus*. Drawn after microphotograph

ABBREVIATIONS

g. opt[1]—peripheral ganglionic layer of optic ganglion
g. opt.[2] — granulate layer
g. opt.[3] — central ganglionic layer
gr.—granulate layer beneath sensory cells
lim. — multiply layered cells of limitans
m.—membrane between cells of limitans and sensory cells
m. h.—limiting membrane toward vitreous body
n. opt.—fiber layer of optic nerve
sens.—pad of sensory cells
st.—rods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g. opt.

Plate XCII

Cirrothauma murrayi CHUN

Ventral view. Station 82 of the *Michael Sars* Expedition

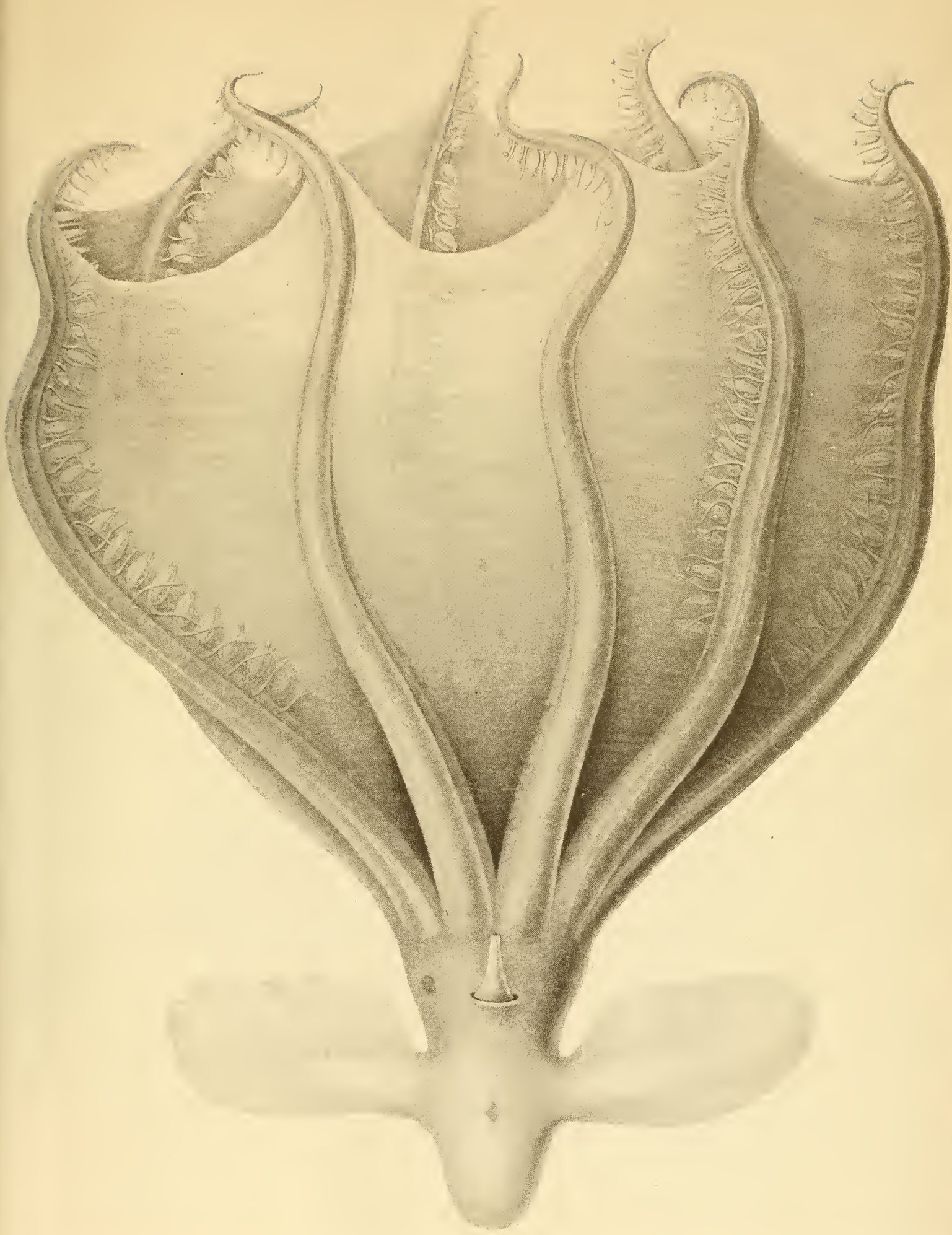

Plate XCIII

Cirrothauma murrayi CHUN

Figure 1. View from mouth. Basal parts of the 8 arms visible
Figure 2. Rudimentary eye.
Figure 3. Retina.

ABBREVIATIONS

a.—outer space surrounding eyeball
alb.—white body
f.—fiber layer
ophth. i. — nervus ophthalmicus inferior
ophth. s. — nervus ophthalmicus superior
opt. — nervus opticus
pg. — pigment of retina
s. — sensory cells
sin. v. — sinus venosus
st. — rods
v. ophth. — vena ophthalmica

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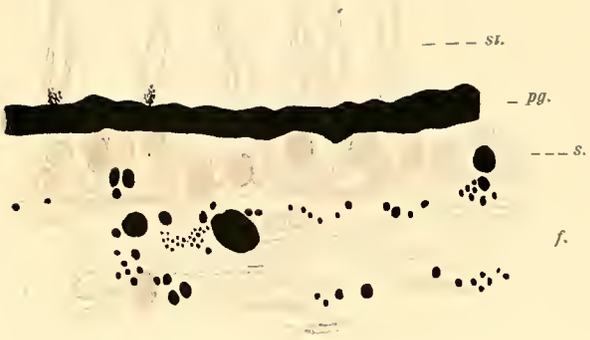

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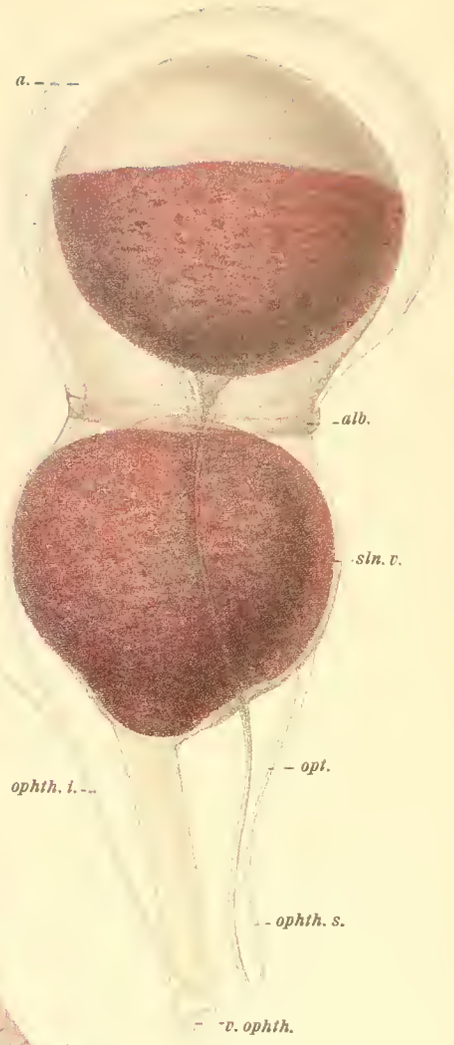

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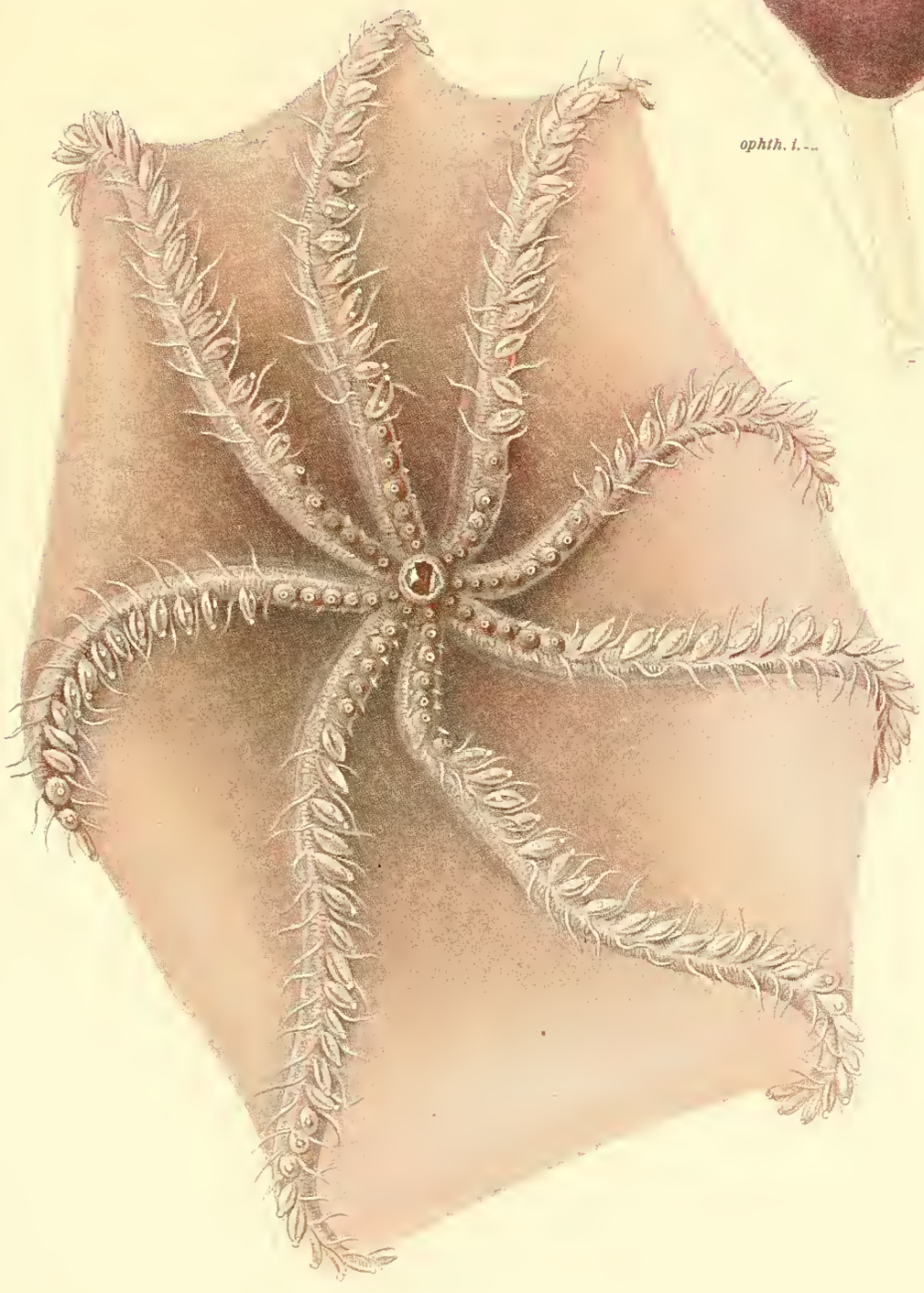

Plate XCIV

Opisthoteuthis VERRILL

Figures 1 and 2. *Opisthoteuthis medusoides* n.sp., Station 243, near Dar es Salaam

Figure 1. Posterior view.
Figure 2. Lateral view.

Figure 3. *Opisthoteuthis extensa* n.sp., Station 189, Mentawei Basin. Posterior view

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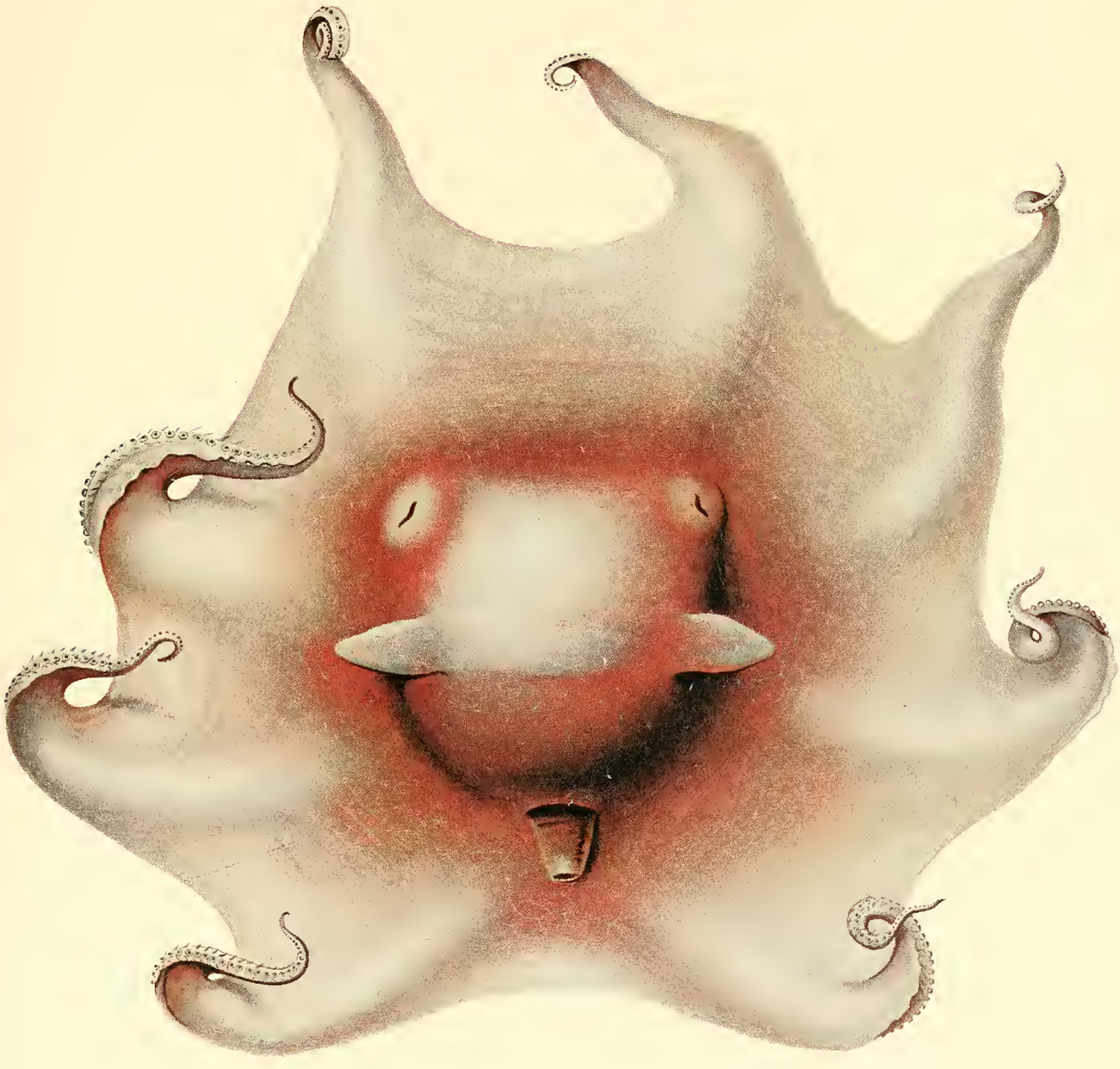

Plate XCV

Opisthoteuthis VERRILL

Figure 1. *Opisthoteuthis medusoides* n.sp. Anterior view
Figure 2. *Opisthoteuthis extensa* n.sp. Anterior view

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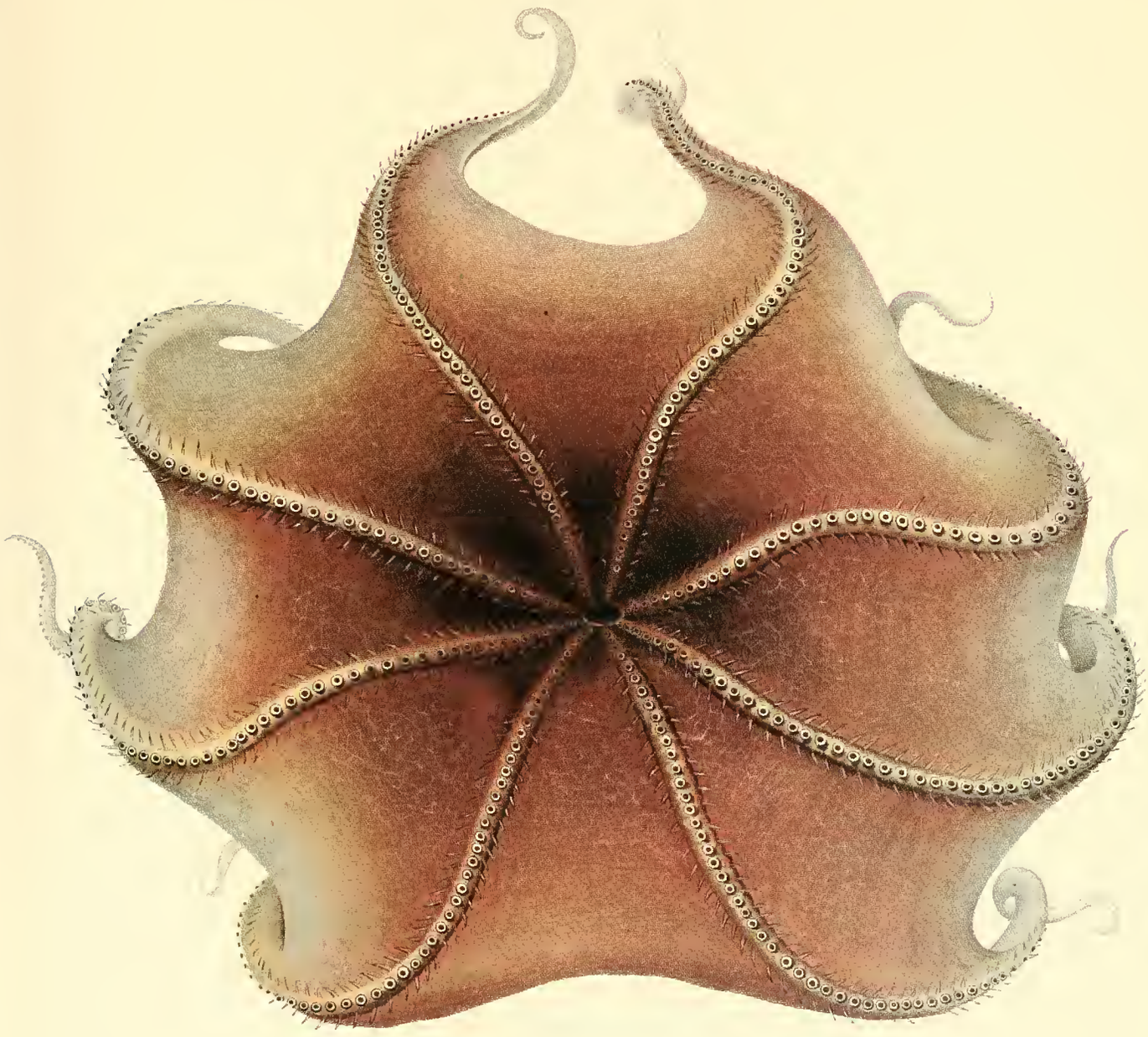

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